Project Summary

1.1 INTRODUCTION

In the past few years, major damage at the Electra has been caused by floods and leaks from failed pipes, components, and contractors negligence. The most significant of these events occurred 2017 when water damaged the elevator machines, resulting in repairs of approximately $300,000 and huge access problems for residents. Another event in 2019 occurred during a pipe repair job by the building contractor. In this instance water flooded the 13th floor and flowed to the exit doors and down the stairs, eventually flooding all the floors below till the 3rd. This resulted in extensive damage to several units and building hallways, ceilings, and walls. Damages amounted to approximately $400,000. Due to these incidents, and other industry-wide insurance factors, insurance premiums and deductibles have increased dramatically.

Events such as the ones noted could have been detected and controlled within minutes if a Smart Automated leak Detection system was installed. This project is intended to address future failures and minimize damage and cost.

In August 2020, Electra Strata engaged E-Factor Engineering, a mechanical systems piping and controls design firm to assist in the design of a system capable of detecting and controlling leaks in the building. E-Factor has worked with Electra and other local strata buildings over the past 10 years and has been operating in Vancouver since 2005.

Automated leak detection systems are becoming more popular with Highrise residential buildings due to the potential damage and high insurance rates. Several companies have products that range from a single control valve and some moisture sensors in a suite to control valve actuators up to 1 ¼" and flow sensors. These systems have WiFi access and cell phone apps that allow a homeowner to turn off the water supply remotely while on vacation. A few of these systems are suited to the type of piping arrangement found at Electra. The components needed to create a system based on the same principles, are available and have been selected for this project.

1.2 PROJECT DESCRIPTION

The objective of this system is the automatic isolation of the building in different zones whenever a major domestic water leak or flood is detected. In order to automatically isolate the building, control valves and flow meters will be installed. Also water sensors will be installed in all the hallways on the floors.

System Layout: Based on the layout of the domestic water plumbing, control valves and flow meters will be installed only on the 3rd and 13th floor, because on these two floors the main water riser pipes distribute to the suites on each floor. This will divide the building into 8 zones as shown in the table below for the residential part of the building and the 3 zones for the commercial area.

Table 1: Control Valves by Group and Zone

Building Section	Valve group	#	*Number of Suites	Floor	Cold	Hot	Floor	Recirc
Residential	**North East _LP**	1	30	3rd	V-10	V-14	11th	V-18
Residential	**North West _LP**	2	40	3rd	V-11	V-15	11th	V-19
Residential	**South East _LP**	3	30	3rd	V-12	V-16	11th	V-20
Residential	**South West _LP**	4	40	3rd	V-13	V-17	11th	V-21
Residential	**North East _HP**	5	22	13th	V-22	V-26	20th	V-30
Residential	**North West _HP**	6	30	13th	V-23	V-27	20th	V-31
Residential	**South East _HP**	7	18	13th	V-24	V-28	20th	V-32
Residential	**South West _HP**	8	34	13th	V-25	V-29	20th	V-33
Total			244					
Commercial	**Mezzanine**	9		Mezz	V-9	V-8		V-7
Commercial	**Main**	10		Mn	V-6	V-5		V-4
Commercial	**First Basement**	11		1st Bsmt	V-3	V-2		~~V-1~~

*Because of the piping arrangement, two valve groups will serve parts of the same suites. Full shut off may require two-zones to be shut off for those suites.

Automated Responses: Both control valves and flow meters will be connected to the site Building Automation System (BAS). The concept is to use the flow meters to learn the building behavior in terms of hot and cold domestic water consumption using the BAS system. The BAS system will collect data from the flow meters and after a two, or four-week period of data monitoring and data analysis, alarms based on typical water consumption, day of week, and time of the day, will be created.

Whenever a sudden major spike in water consumption occurs, or a constant flow occurs for an extended period of time, the system will automatically send a signal to close the associated control valves. To isolate a whole zone, at least three (3) valves have to be shut off - the cold and hot risers plus the hot water recirculation. See Table 2 below for example alarm conditions.

Hot Water Recirculation Piping: To access the recirculation piping, control valves have to be installed on the 11th and 20th floor respectively for low- and high-pressure risers.

Floor Level Water Leak Detection: In addition to this, water sensors will be installed in the hallways and next to the elevator location on each floor (from the 3rd to the 20th). These sensors will detect water leakage and will emit an audible alert. In this case whoever hears the alarm will call the emergency number and then an operator will connect remotely to the BAS and shut off the control valve of the related area.

Control valves and flow meters will be installed inside the ceiling in the common room where the main risers are located: the laundry room for the 3rd floor, and in storage rooms for the 11th, 13th and 20th floors will be considered. Detailed plumbing drawings and specifications have been prepared and Automation system design has been proposed to complete the work.

Alarms and Actions

Alarms created by the system could be sent by email or SMS to building managers and the maintenance staff. In this case maintenance will connect remotely to the BAS and decide to open the valve again as soon as everything goes back to normal.

The same of the types of alarms which will be set up are described in Table 2 below, but their calibration will occur after the installation, during the monitoring and learning period. This is required because each valve zone or group has different number of suites and conditions that will take some trial and testing to properly predict real flood conditions and reduce the number of false alarms.

Table 2: Flood Detection Alarms

Name	Conditions	Sample Value	Additional Notes
High Flow Alarm	$Q > Q_{max}$ [liter/min] for N minutes	Q_{max} = 100 [liter/min] N= 2 minutes	To be calibrated by trial on site
Constant Flow Alarm	$Q > Q_{EXT}$ (Liter/min)over an extended period.	60 L/min for 60 minutes.	Value depend on number of suites in zone and time of day.
User Alert	Flood Detected or Running Water	Flood Detected or Running Water	
Valve Status	Manually closed by program (from the BAS system)	Hot or Cold Water Valve Closed	Maintenance Staff to investigate and act accordingly.
Maintenance condition	Routine maintenance is underway	Hot or Cold Water Valve Closed	

Maintenance Advantages: The control valves can be used for domestic water system maintenance. For example, for short term shut-off during renovations in suites, the system can be used to quickly isolate a zone.

1.3 PROJECT SCHEDULE

The work is to be carried out by three contractors; plumbing, controls and drywall, who will be coordinated and supervised by the Engineering Company, E-Factor Engineering.

The job will be done during daytime. Service disruption will occur only for a 2 to 4 hours during a day and for each zone. The drywall contractor will maintain continuous cleaning of all work areas.

Proposed Trial Phase

Trial project will be carried out on 3rd floor for the South West area (which has the highest number of fixture units) and on the 11th floor where the control valves for the recirculation pipe have to be installed.

Two to three weeks will be needed to analyse the building water consumption and set up the alarms.

Final Phase

The project will be completed in this phase: installation of all the remaining control valves and flow meters on the 3rd, 11th, 13th, and 20th floors will be carried out.

The Gantt chart Figure 1 below shows approximately the steps of the final project, the timelines and the resources allocated for each task.

A few flowmeters will be purchased and installed initially, which will allow for studying the flows in the building and establishing the relevant control settings.

The balance of the flowmeters required will be purchased and installed at a later stage.

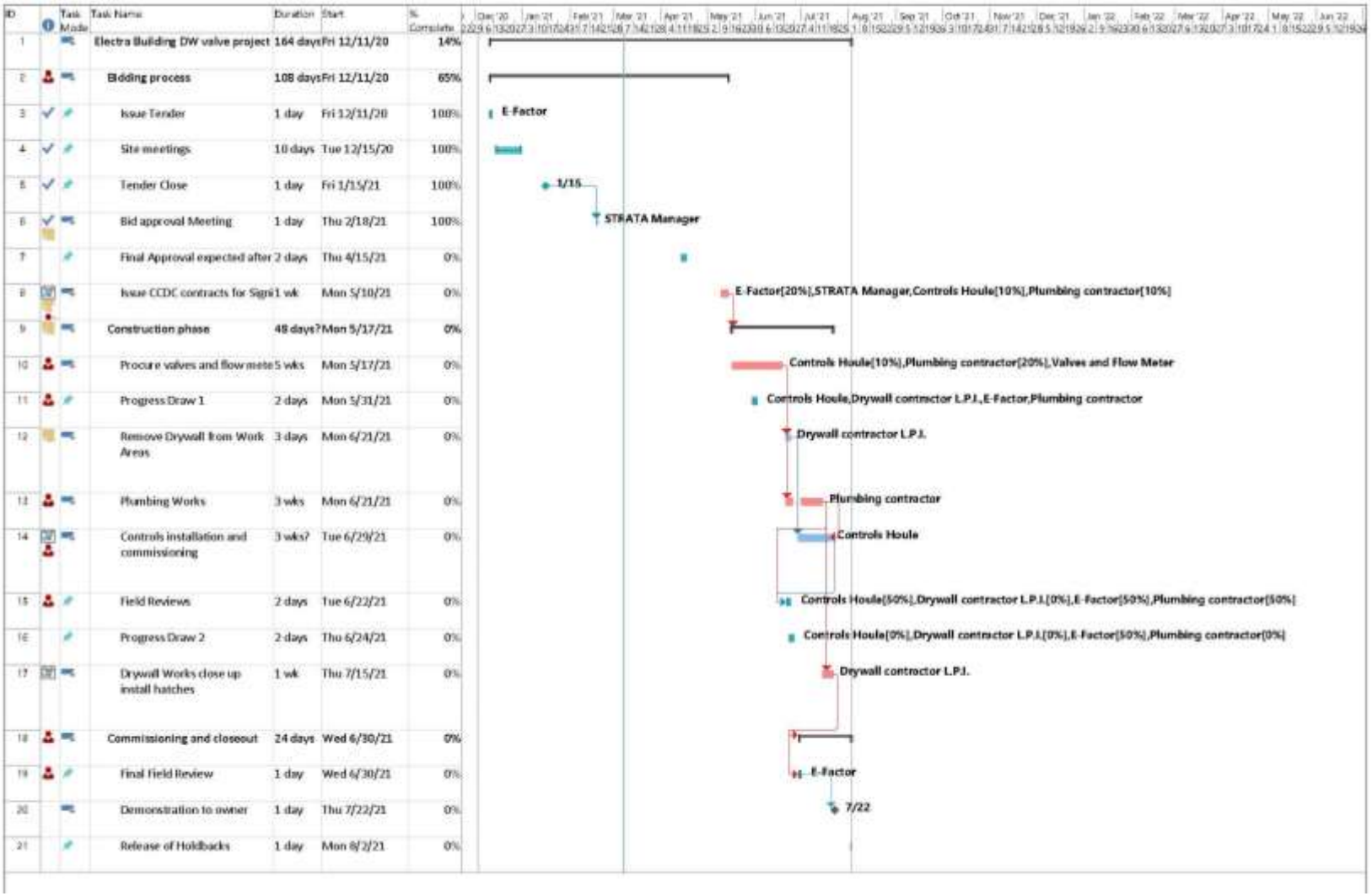

Figure 1: Active Project Schedule