Onondaga County Department of Water Environment Protection

Syracuse Metropolitan WWTP Digester Cleaning and Miscellaneous Repairs Project

Technical Report

July 2013

TECHNICAL REPORT

SYRACUSE METROPOLITAN WWTP DIGESTER CLEANING

AND MISCELLANEOUS REPAIRS PROJECT

Prepared For:

ONONDAGA COUNTY DEPARTMENT OF
WATER ENVIRONMENT PROTECTION

Prepared By:

GHD CONSULTING ENGINEERS, LLC
One Remington Park Drive
Cazenovia, NY 13035

Project No. 8614054

July 2013

Table of Contents

List of Tables

List of Appendices

1 Introduction

The Metropolitan Wastewater Treatment Plant (WWTP) is permitted to treat an average flow of 84 million gallons per day (mgd) of wastewater. The wastewater treatment unit processes consist of raw wastewater screening, grit removal, primary settling, activated sludge aeration, secondary settling, biological aerated filters for ammonia removal, high-rate flocculated setting for phosphorus removal followed by ultraviolet disinfection. Sludge treatment consists of sludge thickeners for primary sludge, gravity belt thickeners for waste activated sludge, and anaerobic digesters followed by centrifuges for sludge dewatering.

The WWTP uses anaerobic digestion to reduce the solids produced from the treatment process and converts them to a stable product. The anaerobic digestion process also reduces pathogens in the sludge and creates methane gas which is used at the plant for energy production, heating, and mixing. The plant has a 375 kW engine/ generator that utilizes methane gas for production of electrical power. Heat from the engine is recovered and reused for sludge heating and building heat.


Metropolitan WWTP

The anaerobic digestion system is a two-stage system. The first stage is primary digestion, which occurs in three 100-foot diameter digesters, each with an approximate liquid capacity of 1.8 million gallons. The second stage is the liquid-solid separation phase which takes place in a secondary digester that is 100 feet in diameter and has a liquid capacity of approximately 1.6 million gallons. The secondary digester is equipped with a gas holder cover and is used for gas storage. The digesters surround a Digester Control House (DCH), where the sludge heating, mixing, cogeneration equipment, piping, and controls are housed. The digesters and DCH make up the digester complex.

GHD was retained to provide engineering services for a project which included design, cleaning, inspection, evaluation, and maintenance/ rehabilitation services for the digester complex. Specifically, GHD developed construction bid documents for emptying and cleaning the digesters and disposing of all sludge from the digesters.


Digester Complex

Table 1-1 summarizes the quantity and actual cost of dry tons of sludge removed from each digester during the project. While the tanks were clean, GHD conducted inspections/evaluations of the interior and exterior structures and equipment associated with each digester and the DCH. After each inspection, an Interim Inspection Report was provided detailing the inspection findings and providing recommendations for repairs, including cost estimates of those repairs. The Interim Inspection Reports are included in the appendices.

Table 1-1 Quantity and Actual Cost of Dry Tons of Sludge Removed

Digester	Quantity of Dry Tons of Sludge Removed	Unit Price	Cost
1	1,368.92	$463	$633,809.96
2	1,593.71	$463	$737,887.73
3	1,444.65	$463	$668,872.95
4	1,026.50	$463	$475,269.50
Total	5,433.78	$463	**$2,515,840.14**

The cleaning of the digesters and associated miscellaneous repairs included Phase 1 of the Digester Rehabilitation Project. This Technical Report summarizes the inspection findings and overall existing conditions of the four digesters and the DCH, and provides recommendations for future rehabilitation, equipment replacement, and additional improvements, including an estimated cost for future repairs/rehabilitation. It also provides a basis of design for major equipment items.

Recommendations were categorized into three phased improvement categories. Phase 1 improvements are defined as those that are either required or recommended to be completed immediately before the digester was placed back in service in order to maintain proper operation of the system, or minor repairs that could be made quickly while the digester was out of service. Phase 2 improvements are improvements that do not need to be done immediately, but should be done within the next 5 to 10 years to maintain efficient operation. Phase 3 improvements are of a lower priority and may be implemented in the future.

The physical condition of the structures and mechanical components of the DCH and digesters was assessed and divided into three qualitative categories: fair or average, good, or poor. For the purpose of evaluation, fair or average condition was defined as being of typical condition as expected for equipment/components of that age. Good condition was defined as being in better-than-average condition as typically seen for the age of the component, and poor condition was defined as being in worse condition than typically seen for the age of that component.

This Technical Report summarizes the major findings and recommendations for the Digester Control House, Primary Digester Nos. 1 through 3, and the secondary digester. More detailed information regarding the findings is provided in the Interim Inspection Reports included in Appendices A through E.

2 Summary of Inspection Findings and Overall Evaluation of Existing Conditions

2.1 Digester Control House

The Digester Control House (DCH) was constructed in 1957 and includes the mechanical equipment, piping, and controls necessary for sludge heating, sludge transfer, gas collection, and digester mixing. This section summarizes the inspection findings of the DCH. Additional details are included in the DCH Interim Inspection Report, included in Appendix E.

2.1.1 Structural

2.1.1.1 Exterior

The exterior of the building is covered with metal siding that was installed in the mid-1980s. The siding appears to be in fair condition with some minor dents. The paint has faded and some of the rivets are rusted. It appears that about 75 percent of the windows were covered when the metal siding was installed. The exposed windows are single-pane glass with metal frames. They are in poor condition with cracked glass and aged hardware. It is recommended that more of the covered window locations be opened to allow natural light in, and all existing windows should be replaced with new energy efficient windows. This work should be considered for Phase 2 improvements.

The existing doors are in fair condition with damage and wear to the paint, hardware, and weatherstripping. We recommended that repair of the exterior doors be considered for Phase 2 improvements.

The main roof was replaced with a typical roofing membrane system in the mid-1990s and is in good condition. Membrane roofs are typically replaced about every 20 to 25 years; a roof replacement should be scheduled in the next 5 to 10 years and be classified as a Phase 2 improvement.

The penthouse roof was recently replaced with an inverted roofing membrane assembly. Its condition could not be assessed due to its assembly, but it is assumed to be in good condition. It is noted, however, that runner crush stone was used instead of conventional round stone for roofing ballast. Runner crush has sharp edges and could potentially tear the exposed roof flashing material and it also tends to compact, which would limit the drainage through the stone. It is recommended the runner crush material be replaced with the conventional round stone used for roof ballast. The replacement of the ballast should be scheduled for Phase 2.

2.1.1.2 Interior

The concrete floors/ceilings are in good condition, but the paint is in poor condition due to typical wear. The steel grating on the first floor that covers an approximate 7-foot by 14-foot floor opening is functional but has some minor damage. The glazed walls are also in good condition, but patches in the walls due to replacement of equipment and other markings should be repaired. We recommended the floors and ceilings be cleaned and repainted; the walls should be cleaned, patched, sanded, and repainted. The steel grating should be replaced with new, more robust galvanized grating. All this work is recommended for completion during Phase 2 improvements.

It was also noticed that the wall penetrations (around conduits) into the Control Room were not completely sealed off, which is necessary due to the rooms' explosionproof classification. Because of the potential hazard of this condition, this repair was classified as a Phase 1 improvement. This work was included in the bid documents of the Phase 1 Digester Project and was completed.

There is also an interior door to the Electrical Room that was used before the conversion of the bathroom into the Electrical Room. In order to separate the areas, this door was sealed off when the bathroom was converted. It was recommended that sealing of this door also be included in the Phase 1 improvements. This work was included in the bid documents of the Phase 1 Digester Project and was completed.

In the basement, the floors and walls are in overall good condition. Some existing floor patches that are starting to crack and come out should be repaired with new patching mortar. There appears to be a leaking joint at the north tunnel junction which should be investigated further and repaired with sealant and/or patching mortar. At the base of the stairs, a pipe is partially embedded in the concrete floor. Since this pipe could be a tripping hazard, it should either be re-routed overhead or be embedded completely below the floor surface. All this work is recommended for Phase 2.

The metal stairs are in good condition, but should be repainted. Condensate receiver equipment below the stairs in the basement has started to cause corrosion on the underside of the stairs due to build-up of condensation. This equipment could be considered for relocation and the condensate receiver vent pipe should be relocated. This work is recommended for Phase 2.

2.1.2 Mechanical

In the DCH, the sludge heating equipment, sludge transfer equipment, gas handling and mixing equipment, and associated piping and valves were inspected. Other miscellaneous building equipment/items were also inspected.

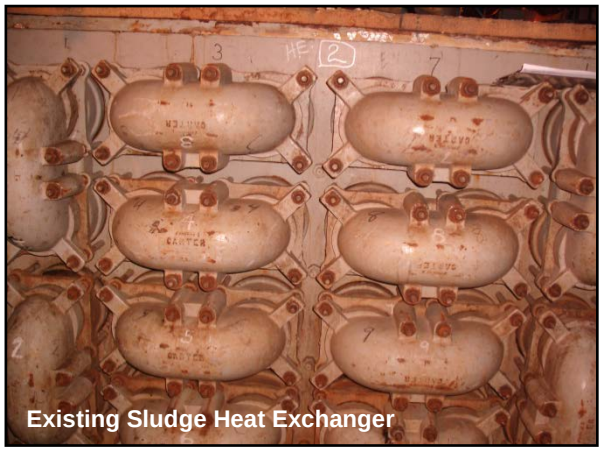
2.1.2.1 Digester Heating System

Generally, the sludge heating system consists of recirculation pumps and valves, sludge heat exchangers, hot water heat exchangers, and hot water recirculation pumps. There are three sludge recirculation pumps in the basement with a capacity of 700 gallons per minute (gpm) at 18 feet of total dynamic head (TDH). The pumps are recessed impeller pumps manufactured by Hayward Gordon and the motors are manufactured by Emerson Electric. These pumps have been in service since 2002. The work order history reviewed on the Computer Maintenance Management System (CMMS) documents that each pump has had an average of two corrective maintenance issues per year since

2002. The majority of these issues were false seal water alarms, plugging, and run failure. Both pumps and motors appeared to be in good condition and plant operators did not indicate any other issues.

There are three “tube and shell-type” sludge heat exchangers in the basement manufactured by the Ralph B. Carter Co. The design heating capacity is 1 million BTU/hour, the design sludge flow is 700 gpm at a pressure of 30 psig, and the design heated water flow is 300 gpm. The heat exchangers have been in service in excess of 35 years and are obsolete because the manufacturer is no longer in business and replacement parts are not readily available. The work order history reviewed on the CMMS documents that these heat exchangers experience approximately two corrective maintenance issues per year. Due to the age of the equipment and unavailability of parts, it is recommended that the three sludge heat exchangers be replaced as part of Phase 2.


Existing Sludge Recirculation Pump


Existing Sludge Heat Exchanger

There are three hot water heat exchangers on the second floor, manufactured by the Carrier Corporation. These heat exchangers have been in service in excess of 35 years. Steam from the Plant Operations Building supplies heat to the hot water via these heat exchangers, which is then circulated through the sludge heat exchanger to heat the sludge. The heat exchangers’ insulation is deteriorating. The work order history reviewed on the CMMS documents that the hot water heat exchangers experience about two corrective maintenance issues per year. The majority of these involved steam valve leaks, steam trap leaks, and low or high temperature. Due to the age of the heat exchangers, it is recommended that each heat exchanger and associated insulation be replaced in Phase 2.

There are three Bell & Gossett hot water recirculation pumps on the second floor that circulate hot water from the heat exchangers to the sludge heat exchangers. The motor nameplates were illegible. These pumps have been in service in excess of 35 years. A visual inspection indicated seal leakage. The work order history on the CMMS documents that these pumps have had few corrective maintenance issues, but those that occurred involved seal and line leaking. Due to the age of these pumps, it is recommended they be replaced as part of Phase 2.

A fourth hot water recirculation pump circulates glycol/hot water solution for heat tracing. This pump is also recommended for replacement during Phase 2.

2.1.2.2 Sludge Valves

Each digester has a number of sludge line plug valves associated with it for isolation. The primary digesters each have 11 sludge isolation plug valves and one 3-way valve. The secondary digester has 13 sludge isolation plug valves and a single 3-way valve. These valves have been in service for over 35 years and have reached their expected useful life. Some of the valve seals were found to be leaking. Due to the location and isolating function of these valves, they can only be replaced when the digester is empty. Therefore, the County requested the valves be replaced during Phase 1 of the project, and such work was included in the bid documents for the Phase 1 Digester Project and was completed.

2.1.2.3 Sludge Transfer System

There are two sludge transfer pumps located in the basement, manufactured by Hayward Gordon, which have been in service for just over 10 years. The 10 HP motors for these pumps are manufactured by Westinghouse Electric. The pumps' main operating point is 250 gpm at 71 feet TDH. These pumps can pump greater than 400 gpm when transferring sludge to the sludge holding tank. Currently, there is only one pump in service; however, the other could be used for digester dewatering. Review of the work order records on the CMMS revealed that these pumps experience about one minor corrective maintenance issue per year. The pumps appear to be in good condition and plant operators did not indicate any major issues. The pumps can be isolated from the system and replaced at any time if necessary. Due to the age and condition of these pumps, no improvements are recommended at this time.

Digester 3 Overflow Box Pipe

One item that was not initially noted in the Interim Inspection Report but was observed later was the condition of the piping in the digester overflow boxes. The condition of this piping is poor, showing severe corrosion and loss of material. It is recommended these pipes be replaced in Phase 2.

2.1.2.4 Digester Gas Handling and Mixing System

The digester gas handling and mixing system includes the gas suction piping and valves, sediment traps, flame arrestors, gas compressors, gas discharge piping, gas distribution manifold, mixing guns (draft tubes), and gas burners. In general, digester mixing is accomplished by recirculating the gas produced throughout the digester with gas compressors. The gas produced in the digester is collected, compressed, and then sent to the draft tubes inside the digester. A large bubble is created in the draft tube which rises and induces sludge to rise up the draft tube, causing a mixing flow.

Gas Piping

The gas produced is collected in the headspace of each primary digester. It is then piped to the DCH for use. First, condensate and sediment is removed from the gas by a sediment trap for each

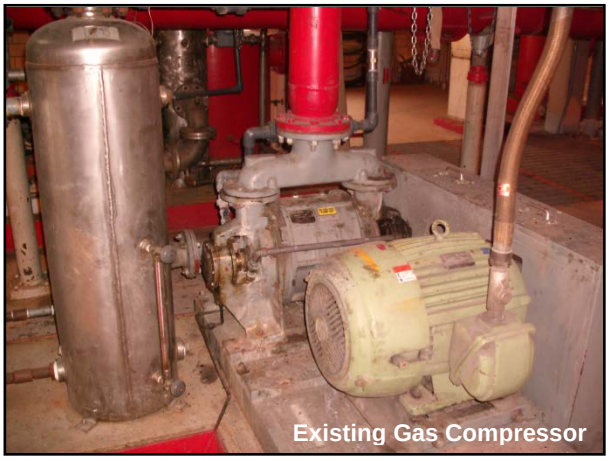
primary digester. There are two sediment traps for each primary digester, located on the second floor of the DCH. The sediment traps are equipped with a drip trap to collect and remove the condensate. The sediment traps are constructed of carbon steel and appear to be in fair condition. However, they have been in service since approximately 1992, and because of their age and the longevity of the system, it is recommended that these units be replaced with new stainless steel traps in Phase 2. The drip traps are constructed of aluminum and appeared to be in fair condition. Because they are constructed of a non-corrosive material, no improvements are recommended.

The gas piping from the primary digesters to the main gas header is through an 8-inch carbon steel pipe. The gas flow flows through the sediment traps and then to the main header. The main gas header is a 14-inch carbon steel pipe which is also connected to the secondary digester (gas holder). Each gas compressor is fed off of this 14-inch header via an 8-inch carbon steel pipe. The discharge piping from the compressors to the balancing manifold is 6-inch carbon steel.

The main header and compressor suction piping was inspected and appeared to be in fair condition. However, there was a section of the Digester 2 gas pipe located on the second floor that had failed previously and was repaired with a pipe clamp. Although there was no evidence of leaking at the repaired section and the repair appears to be adequately working, the pipe is still compromised. It is recommended that this section of pipe be replaced in Phase 2 along with the similar section of pipe for Digesters 1 and 3.

There are five additional 8-inch sediment traps located on the first floor which prevent sediment from entering the compressors. A low pressure manual drip trap (manufactured by Varec) is located at the base of each sediment trap which allows drain-off of condensation. The sediment and drip traps are approximately 17 years old and appear to be in fair condition. Operators did not indicate any maintenance issues. Based on age and longevity of the system, it is recommended that these units be replaced with new stainless steel traps.

Digester Gas Compressors


Existing Gas Compressor

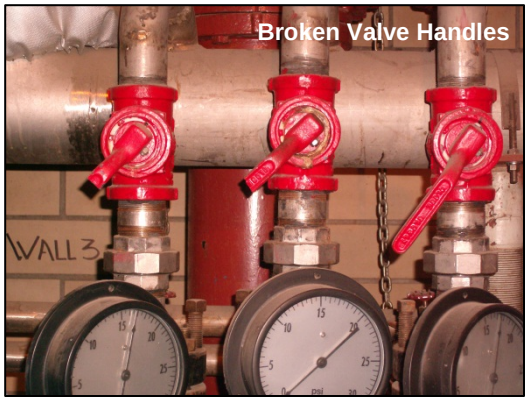
There are five gas compressors (three active, two spare) on the first floor. They are liquid ring pumps, manufactured by Nash Engineering Co. and are approximately 17 years old. The compressor capacity is 370 SCFM at 14.2 psig. The 40 HP motors are manufactured by Emerson Electric. The compressors compress the digester gas before feeding it to the bubble generators on the gas mixing guns. The work order history on CMMS documents that these compressors experience an average of five to six corrective maintenance issues per year, the majority of which involve seal water ball valve cleaning, water leaking, repacking, difficult valve operation, seal water system issues, and belt replacements. It was observed that the compressors appear to be operating at less than their design flow and experienced difficulty providing enough pressure to purge water out of the gas

lines after flushing them with water. Due to this, the maintenance issues, and the fact that the compressors are nearing the end of their useful life, it is recommended these units be replaced as soon as possible, before Phase 2.

Digester Gas Balancing Manifold

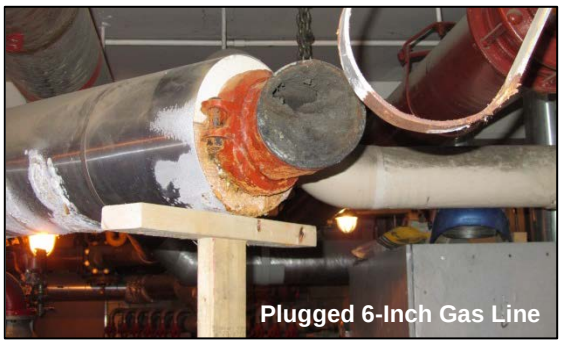
Each digester is equipped with its own gas balancing manifold and balancing valves to each mixing gun used to balance the gas flow between each mixing gun. The balancing valves were 2-inch DeZurik plug valves and have been in use for approximately 17 years. In addition to the balancing valves, each manifold was equipped with 12 isolation valves (also 2-inch plug valves from DeZurik). Plant operators stated some of these valves are inoperable and some valve handles were broken.

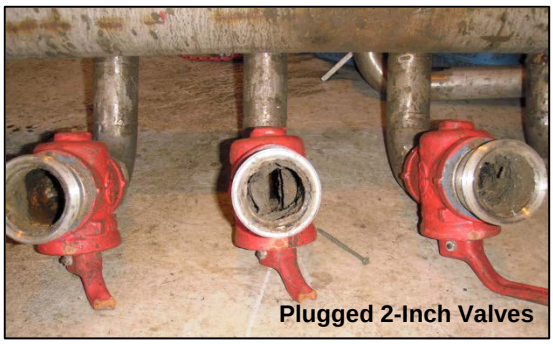

Old Digester 2 Manifold

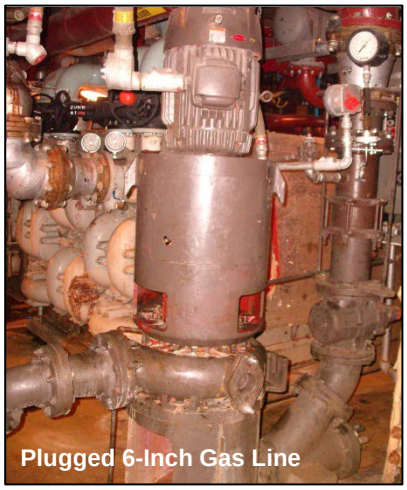


Broken Valve Handles

When Digester 1 was taken out of service, it was discovered that the check valves on the 2-inch gas feed lines to each mixing gun (downstream of the gas balancing manifold) which prevented sludge from backing up from the digester had failed, resulting in sludge plugging the lines all the way back to the compressors. This caused a significant decrease of gas flow to each of the mixing guns and resulted in significantly reduced mixing. It was also discovered that the plug valves on the gas distribution manifold used for isolation and balancing, and the orifice flanges used to measure gas flow, were no longer operational due to the filling and plugging of sludge. It was recommended to immediately replace all of the 6-inch gas piping and check valves downstream of the compressors, the 6-inch manifold assembly including all valves and flow meters, and associated 2-inch gas feed piping in order to regain proper operation of the digester mixing system. This work was completed in Phase 1.


Plugged 6-Inch Gas Line


Plugged 2-Inch Valves



Digester Waste Gas Burners

There are three gas burners on the roof, manufactured by Varec. These burners have been in operation for approximately 12 years. The work order records documented that each gas burner experiences about three corrective maintenance issues per year. The majority of these involve the burners not being able to start or stop and replacing the thermocouple and solenoid. The plant staff stated they were satisfied with the flares, but experienced problems with the ignition system. Due to the age and condition of this system, it is recommended that the ignition system be replaced or rehabilitated in Phase 2.

2.1.2.5 Asbestos

There are asbestos fittings and insulation in the DCH. The following is a summary of the asbestos test report received from the County indicating quantities and condition of the asbestos material.

There are 14 asbestos cement (AC) fittings on fiberglass reinforced plastic (FRP) pipe located in the basement. These fittings were noted to be in fair to good condition. Activity and accessibility were moderate.Thus, it was determined the likelihood of asbestos fibers being released was moderate.

There are 46 fittings on FRP pipe located on the first floor. These fittings were noted to be in good condition, with some showing minor localized damage. Activity and accessibility were moderate. Thus, it was determined the likelihood of asbestos fibers being released was moderate.

There is a total of 136 linear feet of AC insulation and 13 fittings on FRP pipe located on the second floor. These were noted to be in fair condition. Activity was moderate and accessibility was high. Thus, it was determined the likelihood of asbestos fibers being released was moderate.

There is a total of 120 linear feet of AC insulation on piping runs between the DCH and Digesters 1 and 2. These were noted to be in poor condition. Thus, it was determined the likelihood of asbestos fibers being released was high.

There is a total of 264 linear feet of AC roof flashing located on the upper and lower roofs. The material was noted to be in good condition. Thus, it was determined the likelihood of asbestos fibers being released was low.

It is recommended that any removal of asbestos material be completed in accordance with Code Rule 56 of the New York State Department of Labor.

2.2 Primary Digesters

This section summarizes the inspection findings of the primary digesters. Additional details are included in the Digesters 1, 2, and 3 Interim Inspection Reports included in Appendices A-C.


Digester 1


Digester 2


Digester 3


Interior of Digester 2

2.2.1 Structural

2.2.1.1 Interior

The interior concrete walls, roofs, and floors appear to be in good condition with the exception of a few spalled areas on the floors. The concrete appears to be structurally sound with no material loss or damage. There appears to be a coating on the walls, large portions of which have deteriorated. It is unknown if the coating is lead based. We recommended repairing the spalls while the digester was


Digester 2 Wall Coating

out of service; this work was completed in Phase 1. We also recommended recoating all the interior digester walls and roof with high build epoxy coating in Phase 2.

In Digester 3, the walls and roof were replaced in the early 1970s. The concrete roof was replaced with a steel dome. Therefore, some differences from the other primary digesters were discovered. Groundwater was leaking in along the base of the wall/slab interface. Based on the record drawings, there is no waterstop along this interface, just a sealant along the seam coated with coal tar epoxy. A second layer of epoxy material appears to have been applied over this interface which is now starting to separate from the base slab and is cracked at various locations. We recommended the full length of this wall/base slab interface be pressure injected with a polyurethane type of material in Phase 2. This material should stop the leaks immediately and provide a flexible joint that should not crack if movement of the wall or base slab occurs.


Digester 3 Wall/Slab Interface

The failing epoxy coating (approximately 80 square feet) on the wall-to-slab interface should be removed and patched with a polymer-modified cementitious repair material. We recommended completing this repair during Phase 2.

There are vertical construction joints spaced around the perimeter of the Digester 3 tank walls. These construction joints are filled with sealant that appeared to be aged and are starting to deteriorate, but did not indicate any leaking. It is recommended to re-seal these joints in Phase 2.

The bases of the cannon mixers in Digester 3 were also inspected due to visual observations of grout pads in poor condition. At Mixers #2, #3, #6, and #7, the grout pads appeared to have inadequate structural integrity. It was noticed that the baseplates sounded hollow when tapped with a hammer. All other baseplates were investigated and appeared to sound hollow as well. We recommended that all grout pads be repaired immediately by filling the void spaces under all grout pads with new grout and removing and repacking the poor quality grout on Mixers #2, #3, #6, and #7. While the digester was out of service, the County repaired the deteriorating grout pads. Filling of the void spaces was not completed and should be done in Phase 2.

The domed roof of Digester 3 is composed of steel plates attached to steel beams arranged in a radial pattern spanning from the perimeter tank wall to the center ring of the domed roof. In general, the steel framing and plates appear to be in good condition. The suspected coal tar epoxy coating on these members appears to be in poor condition, leaving the paint or primer finish on the steel members exposed. This has resulted in minor surface corrosion at various locations. There are a few isolated areas along the bottom stiffener rim plate of the roof skirt where there is full penetration corrosion. Based on the record drawings, we do not believe the corrosion on the bottom rim plate is a structural concern. We recommended having the steel domed roof sandblasted and recoated with an epoxy coating as a Phase 2 improvement. Prior to recoating, we recommended repairing the badly corroded areas by welding in pieces of new steel plates as a Phase 2 improvement.

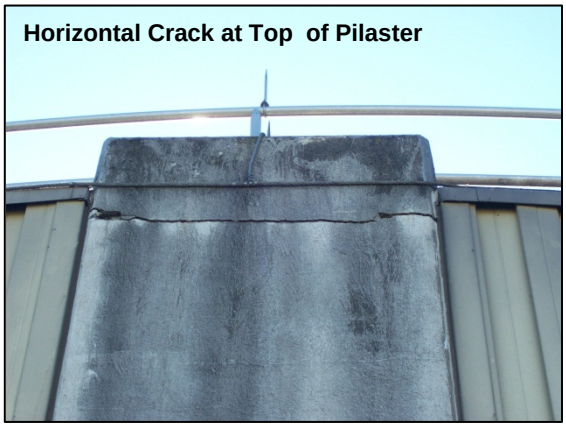
2.2.1.2 Exterior


Broken Roof Insulation

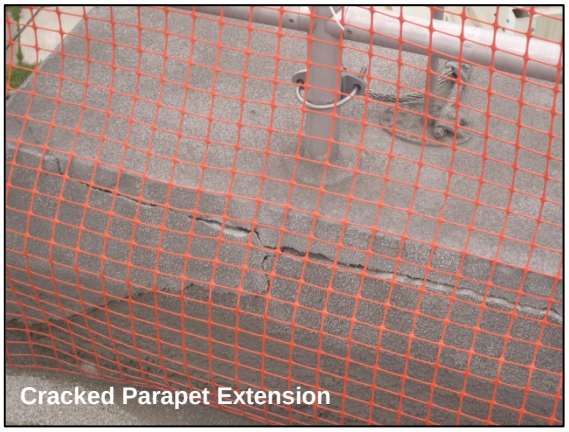
The insulated roofs were found to be in fair condition, with some areas where the shell has broken through. Some of these broken shell areas appear to have been previously repaired. It is estimated that less than 5 percent of the roof area on the primary digesters has this type of damage. As an immediate repair, we recommended patching the broken areas. This work was not completed in Phase 1 but will be done so by the County in the near future. During Phase 2 of the digester repairs, we recommended all of the insulation on the roof be replaced. Complete replacement of the insulation is recommended since all of the insulation has been damaged due to the previously broken shell.

The metal siding appears to be in fair condition with some fading of color and minor damage along the bottom edge which is assumed to have been caused by lawnmowing or some other equipment. It is of no concern other than for aesthetic reasons. No improvements are recommended.

The exposed pilasters appears to have a stucco finish which needs to be repaired in several different areas. There is a significant horizontal crack near the top of every pilaster below the parapet extensions, with the exception of Digester 3, which does not have parapet extensions. Some of the parapet extensions are spalled where the guardrail posts are embedded. In these areas, the concrete has broken away from the face of the concrete wall, leaving inadequate support for the guardrail. In these areas, we recommended that the embedded posts be replaced with surface mounts and the spalls repaired during Phase 1 of the project. This work was not completed in Phase 1 but will be done so by the County in the near future. We recommended repairing the remaining cracks and spalls and recoating the pilasters in Phase 2. We recommended replacing the remaining embedded guardrail posts with surface mounts in Phase 2.


Horizontal Crack at Top of Pilaster


Spalled Plaster


Cracked Parapet Extension


Spall Caused by Embedded Post

On Digesters 1 and 2, the sealant between the top of the tank wall and the flashing cap over the metal siding was cracked at several locations and appears to have exceeded its useful life. We recommended replacing the entire sealant around the perimeter of the tank with an elastomeric sealant in Phase 1. However, since this work is not critical and could be done at any time, it was decided to include it as part of the Phase 2 improvements. Therefore, only the most severely cracked portions were repaired during Phase 1.


Typical Cracked Sealant

2.2.2 Mechanical

The interior mechanical components of the primary digesters consist of sludge withdrawal pipes and supports, sludge feed piping and supports, sludge recirculation and supernatant elbows, digester gas feed piping and supports, digester gas mixing guns (draft tubes), and roof drains, The exterior mechanical components consist of the pressure and vacuum relief valve assembly.

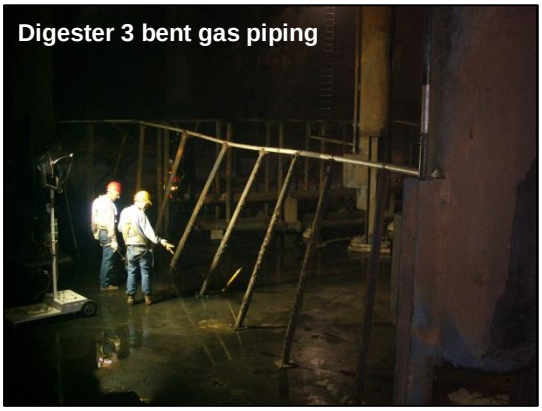
2.2.2.1 Interior

The majority of sludge piping (withdrawal pipes, feed pipes, and recirculation and supernatant elbows) and associated concrete supports appear to be in fair condition. Some of the 8-inch sludge feed pipes had scale build-up in Digester 1 and 3. For Digester 1, the high sludge feed pipe was replaced while the digester was out of service during Phase 1. For Digester 3, both feed pipes had scale build-up. Aided by the contractor, the County was able to clean much of the scale out of the pipe when flushing the pipes. It was determined that these pipes were adequate until Phase 2 and it is recommended that both pipes be replaced at that time.

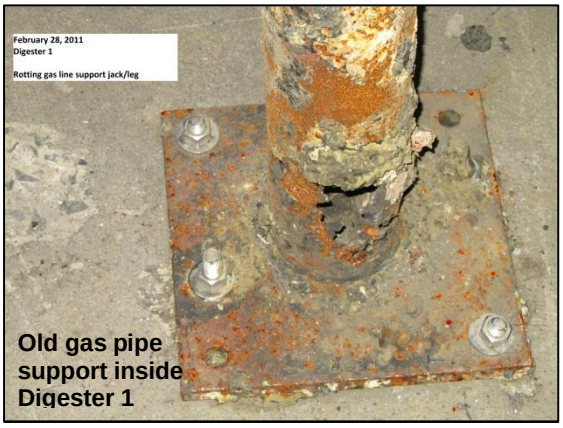

Digester sludge feed pipe with scale build-up

There are 12, 2-inch diameter stainless steel digester gas feed pipes in each primary digester which supply digester gas to 12 mixing guns. Three mixing guns are located in an inner ring and nine mixing guns are located in an outer ring. The 2-inch stainless steel gas pipes discharge at each mixing gun into a "bubble generator" box. The pipes are supported by carbon steel pipe supports. In general, the 2-inch pipes appear to be in fair condition. The only exception was Digester 3, where some of the gas piping and supports had failed and were fallen over. About 120 linear foot of 2-inch stainless steel gas piping and associated supports required immediate replacement in Digester 3. This work was completed in Phase 1.


Existing digester pipe penetrations

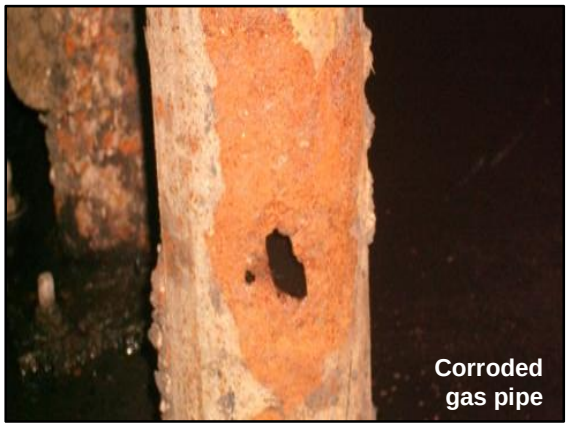

Digester 3 bent gas piping

In Digesters 1 and 3, the carbon steel supports for the 2-inch gas feed piping were found to be in poor condition, showing signs of severe corrosion. In some cases, the support was completely corroded through. In Digester 2, the supports were in better condition with only some minor surface corrosion. It was recommended that the supports be replaced in kind using stainless steel in lieu of carbon steel for Digesters 1 and 3 to ensure adequate support of the gas piping. This work was completed in Phase 1. We believed that the supports in Digester 2 were capable of adequately supporting the gas pipe until Phase 2, and thus recommended their replacement in Phase 2. The County agreed but also decided to recoat them while the digester was out of service to increase their longevity.



Old gas pipe support inside Digester 1

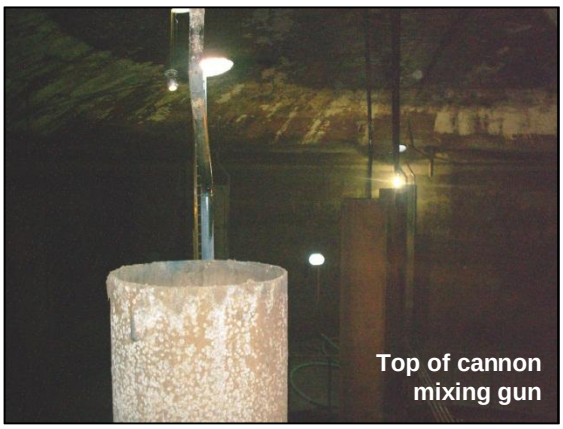

Existing digester pipe supports


Corroded gas pipe


Corroded gas support

The mixing guns (draft tubes) and bubble generators appear to be in fair condition; however, much of the coating has worn off. No loss of structural thickness was observed for the mixing gun tubes. It is recommended that the mixing guns be recoated in Phase 2. Some loss of material and corrosion was found around the throttle plate openings at the bottom of the bubble generators. It was recommended to repair these corroded areas while the digester was out of service to prevent further damage. This work was completed in Phase 1. The openings were all still in compliance with the manufacturer's specifications. It is recommended that the bubble generators be either recoated or replaced with new stainless steel bubble generators in Phase 2.


Looking down inside of mixing gun


Top of cannon mixing gun

The roof drains in Digesters 1 and 2 are internal to the digester. They were made of cast iron and original to the digester. The roof drains appeared to be in poor condition and some of the joints appeared to be leaking. The pipe showed signs of pitting and corrosion. When water was added to one of the roof drains, it was found that the mechanical seal had failed and was leaking. Also, the roof drain supports were severely corroded and broken in some places. It was recommended that the roof drains in


Roof drain link seal

Digester 1 be replaced during Phase 1. This work was completed. In Digester 2, the roof drains were in better condition and were not recommended for replacement during Phase 1. However, the County requested they also be replaced during Phase 1. This work was completed.

2.2.2.2 Exterior

The pressure/vacuum relief valve assemblies were wrapped in insulation. The plant staff has not experienced any issues with the assemblies. No improvements are recommended at this time regarding the pressure/vacuum relief assemblies.


Typical pressure/vacuum relief assembly

2.2.2.3 Pipe Chase

Groundwater is leaking in the joints of the pipe chase, leaving the majority of the pipe chase submerged. The groundwater had to be pumped out to observe the pipe chase. The piping in the pipe chases was wrapped with submersible insulation which did not allow for assessment of the piping. The insulation appears to be in fair condition in Digesters 1 and 3, but poor condition in Digester 2. Some of the wrapping fell off the piping. It is recommended this wrapping be replaced in Phase 2 in order to adequately protect the piping. Digesters 2 and 3 had sludge on the bottom of the pipe chase which should be removed during Phase 2 because it is a safety hazard. The pipe supports in the chase appear to be in good condition.


Digester No. 1 pipe chase


Digester 2 pipe chase missing insulation


Bottom of Digester 2 pipe chase showing missing insulation and sludge

2.3 Secondary Digester (Digester 4)

This section summarizes the inspection findings of the secondary digester. Additional details are included in the Digester 4 Interim Inspection Report included in Appendix D.

2.3.1 Structural

2.3.1.1 Digester Cover


Digester 4


Digester 4 cover rust

The secondary digester is equipped with a gas holder-type floating cover which maintains a set pressure so the volume of gas can increase or decrease as it is used. The carbon steel cover panels and structural members on the interior of the cover appear to be in good structural condition. It appears that sections of the interior of the cover had been more recently rehabilitated than others. Hence, some sections of the inside of the cover showed more corrosion than others. However, between these different sections, no variation in structural thickness could be measured. Therefore, we believe that the corrosion is limited to the surface. On the exterior top section of the cover, the coating appears to be in fair condition with some areas of corrosion. Also, during inspection it was discovered that the floating gas holder cover was visibly tilted, caused by the cover tie rods failing. In the future, if the cover is to be rehabilitated, we recommended removing the entire cover from the digester to aid in a full rehabilitation of the cover and tank. Removing the cover is necessary in order to access the center column, skirt, and walls. Cover rehabilitation should include: (1) sandblasting and recoating the cover; (2) sandblasting and recoating the center column; and (3) sandblasting and recoating concrete walls.

2.3.1.2 Digester Skirt

The interior of the digester skirt appears to be in good condition with only minor surface corrosion. One section of the vertical skirt was damaged such that a parabola-shaped crease was formed. This crease does not appear to pose a structural or functional problem. This deformation was not identified in the 1999 inspection report. Some of the vertical stiffeners are slightly bent where the diagonal tie-rods are connected. These bent stiffeners do not appear to impair the structural integrity of the cover. Because these issues do not pose structural problems, no improvements or repairs are recommended.

2.3.1.3 Center Column

The center column assembly appears to be in good condition. The inner column appeared to have been coated with coal tar epoxy which is failing in several sections along the length. We recommended recoating the center column at the same time the cover is rehabilitated.

2.3.1.4 Tie Rods

The 12 tie rods that stabilize the inner center column assembly (Type A) appear to be in good condition. One of the tie rod anchor plates on the concrete is cracked. The condition of the plate is consistent to what was described in the 1999 inspection report and does not appear to have deteriorated further. Three of the four anchor bolts are unaffected by the crack, which is limited to the top right corner of the plate. However, while the digester was out of service, we recommended either repairing by welding or replacing this plate in kind. This work was completed in Phase 1.

Eighteen diagonal tie rods connect the top perimeter of the cover to the base of the exterior moveable column. Each diagonal tie rod (Type B) consists of five segments connected to each other with threaded turnbuckles. Each rod is connected to a hub at the base of the outer (moveable) center column with a hemispherical nut. Over time, many of the tie rods unscrewed from the turnbuckles and fell to the floor of the digester. Many of the fallen tie rods were bent. No issues with these rods were identified in the 1999 inspection report. The diagonal tie rods are necessary for the structural integrity and balance of the cover over its range of travel. Therefore, it was recommended to replace as necessary and reinstall the tie rods before the digester was placed back in operation. This work was completed in Phase 1.


Digester 4 broken tie rods


Digester 4 broken tie rods

The six horizontal tie rods (Type C) appear to be in good condition and were intact with the exception that some of them were slacked. These tie rods are also composed of sections joined with threaded turnbuckles. We recommended all of these rods be tensioned. The rods are pinned to connecting plates welded to the moveable center column. Two of the connecting plates at the center column assembly had large deformation (wear) of the mounting holes that appeared to have been caused by movement of the tie rods over time. This work was completed in Phase 1.

2.3.1.5 Cover Guide Angles

Four guides are installed on the digester walls to prevent rotation of the cover. The guides are constructed of vertical steel angles bolted to the concrete wall. Each angle engages a fin welded to the exterior of the cover skirt. Three out of the four digester cover guide angles appear to be in good condition and one guide angle appears to have been modified. This modification may have been added to alleviate binding of the cover. No improvements to the cover guide angles are recommended.

On the inside of the cover skirt, there are indentations where the fin attachment is welded to the skirt. Some of these indentations are corroded, and if allowed to corrode further could create a through-hole and result in a point for leakage of gas. In order to protect this area from corrosion, we recommended welding a steel plate on the inside of the digester skirt over the area of the indentations. This work was completed in Phase 1.

2.3.1.6 Interior Concrete

The interior surface of the concrete tank wall and floor appears to be in good condition. The concrete wall appears to have been coated and some areas have deteriorated. There did not appear to be a coating on the floor. Overall, the concrete corbels appear to be in good condition; however, there was some slight spalling. We recommended the interior walls be recoated at the same time the cover is rehabilitated in Phase 2.

2.3.1.7 Exterior

The pilaster appears to be in fair condition, with some dark staining and horizontal cracking. The stucco-type coating needs to be repaired in several areas. There is a significant horizontal crack along the top of every pilaster. The inside face and tops of the pilasters have damage due to cracking and deterioration. We recommended repairing the cracks and recoating in Phase 2.


Spalled/cracked parapet extension on Digester 4


Typical pilaster

2.3.2 Mechanical

2.3.2.1 Interior

The pipes, fittings, and pipe supports in the digester appear to be in good condition. We observed the pipe penetrations and found no apparent signs of leakage. The pipe penetrations appear to be sealed with a lead caulking. No improvements to the interior mechanical components are recommended.

2.3.2.2 Exterior

The piping and valves on top of the digester cover appear to be fairly new and in good condition. No improvements to the exterior mechanical components are recommended.

2.3.2.3 Pipe Chase

The pipe chase is below grade and houses all of the below-grade piping between the two structures. It is approximately 10 feet wide by 10 feet tall by 30 feet long. Under normal conditions, the bottom half of the chase is below groundwater level. Therefore, the chase had to be pumped out for the inspection. The groundwater appears to be entering at gaps in the connection of the chase to the DCH. It is recommended these gaps be sealed to reduce the groundwater surcharge in the pipe chase. These gaps can be sealed at any time and are therefore considered Phase 2 improvements.


Corroded 14-inch wall sleeve

The pipes in the pipe chase are ductile iron and appear to be in good condition. Most of the pipes and couplings located below the normal groundwater level have been coated with a coal tar epoxy which has protected the piping from corrosion. Replacement of pipe is not necessary or recommended.

The pipe penetrations and link seals appear to be in good condition. Replacement of link seals is not necessary or recommended. However, the wall sleeve for the penetration of the 14-inch gas line is corroded. This corrosion should be sandblasted and recoated with coal tar epoxy. This work can be done at any time and is recommended to be completed as a Phase 2 improvement.

The pipe supports were observed and they appear to be in good condition. No improvements to the pipe supports are recommended.

The couplings were also observed. Seven 8-inch couplings showed corrosion. All of the corroded couplings are on pipes that did not have coal tar epoxy protection and experience occasional submergence. It was recommended that these seven couplings be replaced while the digester was out of service. This work was completed in Phase 1.

The coal tar epoxy coating is flaking off the pipes. It was recommended that the existing piping and couplings in the pipe chase which have a coal tar epoxy coating be sandblasted and recoated with coal tar epoxy for protection. In addition to this, all of the existing piping and couplings which are not

coated should be coated with coal tar epoxy. This work can be done at any time and is considered a Phase 2 improvement.

3 Phase 1 Repairs/Upgrades Summary

After inspections, Phases 1 and 2 repair recommendations were made. This chapter summarizes the actual repairs made during this project and includes the cost of each repair. Table 3-1 lists the actual Phase 1 repairs/improvements and includes the cost of each..

3.1 Digester Control House

Several Phase 1 improvements were made to the DCH during this project. The major repairs involved improvements to the gas mixing system. During construction, it was discovered that the 6-inch gas compressor discharge piping was completely plugged with sludge as a result of check valve failure on the 2-inch gas feed piping. For each of the five compressors, the existing steel 6-inch diameter gas compressor discharge piping header was replaced with new Schedule 40 stainless steel grooved pipe. For each primary digester, the existing stainless steel 6-inch gas discharge manifold, the entire gas balancing manifold system including balancing and isolation plug valves, and associated 2-inch diameter stainless steel piping were replaced. The new manifold is equipped with new stainless steel ball valves and new rotameters for gas flow measuring.


New 6-inch stainless steel gas piping

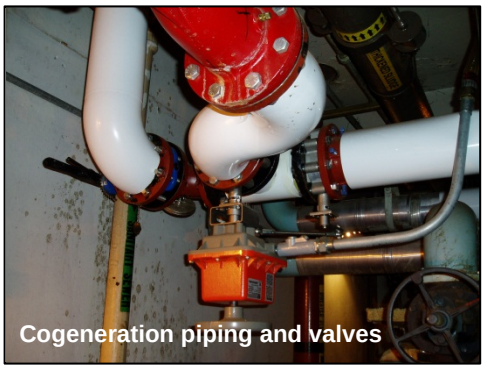

New Digester 2 manifold


New Digester 3 manifold

During construction of this project, County personnel informed us of the operational problems of the cogeneration system. GHD evaluated the system and found that the tandem butterfly valves were improperly installed and required relocation. The valves were subsequently moved to the correct locations.

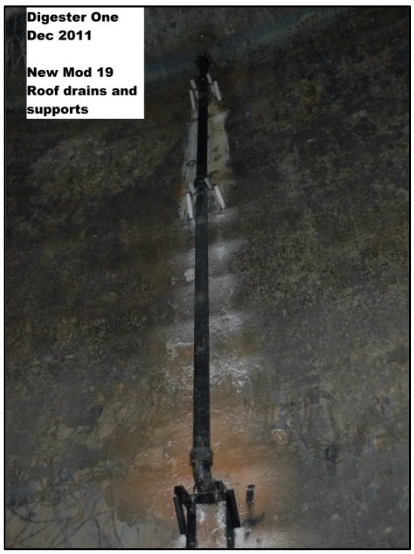
Also, seven air release valves were added at highpoints in the piping to reduce the potential for air buildup in the line.

As part of the contractual repairs, 6- and 8-inch diameter sludge valves and 3-way valves were replaced, as well as the addition of new 6-inch isolation plug valves on the 6-inch gas header.


Cogeneration piping and valves

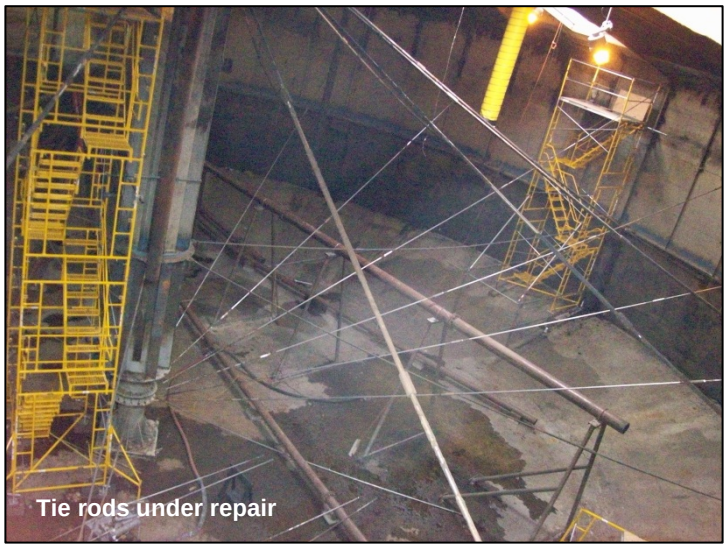
3.2 Primary Digesters

Several Phase 1 improvements were made to the primary digesters. The major repair/upgrade was the addition of the "Hartford Loop" on all 2-inch gas feed lines for each mixing gun. The Hartford Loop is an extension of the 2-inch gas feed piping which rises above the maximum water level so that sludge cannot back up beyond the loop, protecting any piping and equipment upstream of the loop. The Hartford Loop is an improvement to the gas mixing system that reduces the possibility of sludge backing up the piping to the DCH. The system no longer relies on check valves to hold back the pressure of the sludge. The new Harford Loop arrangement will maximize mixing efficiency and gas production.



3.3 Secondary Digester

Several Phase 1 improvements were made to the secondary digester (Digester 4). The major repair/upgrade was the rehabilitation of the existing 50-year old floating steel cover. This included replacing and tensioning the damaged stainless steel tie rods; adding locking nuts at the turnbuckles connecting the rods to prevent the tie rods from coming undone again; repair of indentations on the digester skirt; replacement of two deteriorated tie rod connection plates; and balancing and leak testing the rehabilitated cover under the supervision of the manufacturer.



Tie rods under repair

Table 3-1 Phase 1 Repairs/Improvements

Repair/Upgrade	Quantity	Per	Installed Cost
DIGESTER CONTROL HOUSE			
Replace 6-inch sludge isolation plug valves	20	Contract	$28,000
Replace 8-inch sludge isolation plug valves	22	Contract	$32,000
Replace 3-way 8-inch sludge isolation plug valves	4	Contract	$25,000
Add new 6-inch gas isolation plug valve	3	Contract	$28,000
Seal Electrical Room penetrations		Contract	Negligible
Relocated cogeneration loop tandem valves; added seven air release valves	N/A	Modification	$30,000
Replaced all gas compressor 6-inch carbon steel discharge piping with stainless steel grooved joint pipe; replaced 6-inch compressor discharge check valves; replaced 3-inch bypass line and plug valve	N/A	Modification	$86,000
Replaced balancing manifold assembly for each primary digester including new 2-inch stainless steel pipe, ball valves, rotameters	3	Modification	Included under Hartford Loop
Replaced an additional six 6-inch sludge plug valves and seven 8-inch sludge plug valves	15	Modification	$30,000
Total Digester Control House			**$259,000**
DIGESTER 1			
Removed layer of hardened sludge on digester wall	N/A	Modification	$38,000
Added Hartford Loop to 2-inch gas feed lines internal to the digester	12	Modification	$110,000
Replaced carbon steel gas feed pipe supports with stainless steel	65	Modification	$72,000
Modified sludge withdrawal piping so there are now two different withdrawal elevations	N/A	Modification	$13,000
Replaced roof drains, roof drain supports, and link seals	3	Modification	$32,000
Replaced sludge feed pipe	50 LF	Field Order	$2,045
Rotated all throttle plates to the correct position (approximate 4-inch x 2-inch opening)	12	Owner completed	
Replaced 4-inch plug valve at differential pressure level transmitter	1	Contract	$2,000
Patched floor spall, repaired manway riser spall	1	Field Order	$1,782

Table 3-1 (continued)

Repair/Upgrade	Quantity	Per	Installed Cost
Provided a 100 SF coating test patch for future baseline monitoring of concrete protection	100 SF	Unit price item	$3,000
Replaced Varec gaskets on manway openings on cover	1	Modification	$2,000
Total Digester 1			**$280,000**
DIGESTER 2			
Removed layer of hardened sludge on digester wall	N/A	Modification	$41,000
Added Hartford Loop to 2-inch gas feed lines internal to the digester	12	Modification	$110,000
Recoated carbon steel gas feed pipe supports	65	Owner completed	--
Replaced missing gas feed support pipe clamps	N/A	Owner completed	--
Modified sludge withdrawal piping so there are now two different withdrawal elevations	N/A	Modification	$13,000
Replaced roof drains, roof drain supports, and link seals	3	Modification	$32,000
Rotated all throttle plates to the correct position (approximate 4-inch x 2-inch opening)	12	Owner completed	--
Replaced 4-inch plug valve at differential pressure level transmitter	1	Contract	$2,000
Patched floor spalls	1	Field Order	$36
Replaced Varec gaskets on manway openings on cover	1	Modification	$2,000
Total Digester 2			**$200,000**
DIGESTER 3			
Removed layer of hardened sludge on digester wall	N/A	Modification	$33,500
Added Hartford Loop to 2-inch gas feed lines internal to the digester	12	Modification	$110,000
Replaced carbon steel gas feed pipe supports with stainless steel	65	Modification	$60,000
Modified sludge withdrawal piping so there are now two different withdrawal elevations	N/A	Modification	$13,000
Replaced 12, 2-inch carbon steel nipples on gas feed to bubble generator	12	Modification	$2,400
Replaced throttle plates on Mixers 9 and 11	2	Field Order	Negligible
Rotated all throttle plates to the correct position (approximate 4-inch x 2-inch opening)	12	Owner completed	--

Table 3-1 (continued)

Repair/Upgrade	Quantity	Per	Installed Cost
Repaired corrosion on bubble generator throttle plate openings for Mixers 6, 9, and 11	3	Field Order	Negligible
Repaired corrosion on bottom of Mixer 10 draft tube	1	Field Order	Negligible
Replaced 4-inch plug valve at differential pressure level transmitter	1	Contract	$2,000
Replaced Varec gaskets on manway openings on cover	1	Modification	$2,000
Total Digester 3			**$220,000**
DIGESTER 4			
Replaced and retensioned cover tie rods	N/A	Modification	$50,500
Repaired cracked anchor plate anchoring center column stabilization tie rod	1	Modification	$250
Repaired indentations in digester skirt where cover fins are welded by welding new steel plate over indentations	16	Field Order	Negligible
Repaired spalled concrete corbels	5	Field Order	$180
Replaced 4-inch plug valve at differential pressure level transmitter	1	Contract	$2,000
Balanced and leak tested floating cover	N/A	Modification	$13,500
Replaced seven 8-inch pipe couplings in pipe chase	7	Modification	$8,000
Total Digester 4			**$75,000**
TOTAL PHASE 1 REPAIRS/IMPROVEMENTS			**$1,034,000**

4 Phase 1 Recommended Repairs Not Completed

This chapter lists repairs that were recommended to be completed during Phase 1, but were not completed during Phase 1 for various reasons, including time constraints, budget constraints, and low priority. These repairs should be moved to Phase 2.

Digester 1

1. Repair cracked pilasters.
2. Repair spalled pilasters.
3. Coat pilasters/parapet extensions with a protective elastomeric coating.
4. Repair cracks in parapet extension.
5. Repair spalls caused by embedded guardrail posts.
6. Replace embedded guardrail posts with surface mount posts.
7. Replace sealant between the top of the tank wall and flashing cap around entire perimeter of digester.
8. Patch insulated roof (unless replacing).

Digester 2

1. Replace sealant between the top of the tank wall and flashing cap around entire perimeter of digester.

Digester 3

1. Fill void space of grout pad with new grout under each mixing gun.
2. Repair spalled concrete at the six embedded guardrail posts.
3. Seal gap between mixing gun flushing pipe and steel sleeve to prevent water damage.

5 Recommendations for Phase 2: Future Rehabilitation and Equipment Replacement

5.1 Digester Control House Phase 2 Recommendations

Phase 2 repairs/improvements are those that are not immediately necessary, but should be done in the next 5 to 10 years. The Phase 2 recommendations for the DCH are documented in the DCH Interim Inspection Report (revised February 4, 2013) and also discussed in Chapter 2 of this report. Table 5-1 on the following page lists the Phase 2 recommended repairs and associated costs for the DCH.

5.1.1 Glycol System

The interim report suggested replacing the existing glycol system with electrical heat tracing; however, further evaluation should be made regarding replacement with a similar glycol system versus an electrical heat trace system. A third option may be reusing the glycol system in place and simply replacing the asbestos insulation with new insulation.

5.1.2 Sludge Heat Exchangers

The sludge heat exchangers should be replaced with either a similar tube and shell type or a spiral type. One of the benefits of the spiral type is a reduced footprint. Further comparison of the heat transfer capabilities of each type should be made to determine the preferred style.

Table 5-2 summarizes the basis of design for the major pieces of equipment proposed for Phase 2 replacement.

Table 5-2 Phase 2 Equipment Replacement Basis of Design

Unit Process/Equipment	Design Criteria	Value
Sludge heat exchangers	No. of units Type Heating capacity Sludge flow/pressure Hot water flow	3 Spiral or tube and shell 1 million BTU/hr 700 gpm/30 psig 300 gpm
Hot water heat exchangers	No. of units Flow	3 300 gpm
Hot water circulation pumps/motors	No. of units Flow	3 300 gpm
Gas compressors	No. of units Type Flow Pressure Discharge pressure range Motor HP	5 (3 active, 2 spare) Liquid ring compressors 370 scfm 12 psig Up to 21 psig 40

5.1.3 Gas Compressors

After installation of the Hartford Loop in the digesters, it was observed that the existing compressors had difficulty purging flush water out of the piping after flushing the lines with water. This led to an expedited

schedule for replacing the existing aging compressors with new units capable of applying a greater discharge pressure. The estimated total project cost of replacing the compressors as a separate project is $570,000. This amount includes new or modified equipment pads and ancillary equipment.

5.2 Primary Digesters Phase 2 Recommendations

The Phase 2 recommendations for the primary digesters are documented in the Digesters 1, 2, and 3 Interim Inspection Reports and are also discussed in Chapter 2 of this report. The following is a list of recommended Phase 2 repairs for the primary digesters.

1. Replace insulation on exterior of roof.
2. Coat roof insulation with silicone coating.
3. Recoat interior roof and walls.
4. Recoat mixing guns/bubble generators.
5. Repair cracks in pilasters.
6. Repair spalls in pilasters and parapet extensions.
7. Recoat pilasters with an elastomeric protective coating.
8. Replace sealant between the top of the tank wall and the flashing cap over the metal siding (Digesters 1 and 2).
9. Replace embedded guardrail posts on top of tank with surface mount posts and repair spalls.
10. Seal leaking joints in pipe chase.
11. Replace damaged and missing piping insulation in pipe chase (Digester 2 only).
12. Clean sludge out of pipe chases.
13. Pressure injection grouting of wall/slab interface (Digester 3 only).
14. Remove failing epoxy coating of wall/slab interface and patch with a polymer modified cementitious repair material (Digester 3 only).
15. Clean out vertical construction joints and install new backer rod and polyurethane sealant (Digester 3 only).
16. Sandblast and recoat roof stairs/platform leading to digester.
17. Replace sludge feed pipes back to DCH (Digester 3 only).

Tables 5-3 through 5-5 list the recommended Phase 2 repairs and associated costs for the primary digesters.

5.3 Secondary Digester Phase 2 Recommendations

The Phase 2 recommendations for the secondary digester are documented in the Digester 4 Interim Inspection Report and discussed in Chapter 2 of this report.

Rehabilitation of the gas holder floating cover during Phase 1 will result in an extension of life for the cover. It is recommended the cover be evaluated again in 5 to 10 years to assess its condition, including ultrasonic thickness testing of the skirt and dome to determine if the cover still retains structural integrity.

During Phase 2, it is recommended that the cover be either rehabilitated (sandblasted and recoated) as long as there is still structural integrity, or replaced. There are two options for replacement of the cover. One option is to replace with a steel or fiberglass cover similar to the existing cover. The other option is to replace with a membrane cover.

For the purposes of this analysis, costs were compared for steel versus a membrane-style cover. The two types of covers were compared using a life cycle cost analysis. In this analysis, the present-worth cost was determined for each option based on an expected lifetime of a steel cover of 30 years. The life cycle approach considers the construction costs, operational and maintenance costs, and replacement costs over the 30-year lifetime. The maintenance cost of the steel cover includes recoating every 10 years. The maintenance cost of the membrane cover includes maintaining the fans. Each type of cover has advantages and disadvantages, as described in Table 5-6. Table 5-7 presents a basis of design for each option based on Ovivo models.

Table 5-6 Cover Type Advantages and Disadvantages

	Steel Cover	Membrane Cover
Advantages	• High life expectancy (30+ years)	• Greater gas storage capability • Lower equipment cost • Lower installation cost • Faster installation (typically in 2 weeks)
Disadvantages	• Higher initial equipment cost • Significantly higher installation cost (highly skilled crew, welding, and painting on site) • Longer installation duration • Less gas storage	• Shorter life expectancy (10 to 15 years)

Table 5-7 Gas Holder Cover Basis of Design

	Steel Gasholder	Membrane Gasholder
Vacuum load (in W.C.)	2	2
Design pressure (in W.C.)	18	7.4
Operating pressure (in W.C.)	12	5.4
Relief pressure (in W.C.)	14	7.4
Escape pressure (in W.C.)	16	N/A
Gas storage capacity (ft^3)	113,631	261,717
Maximum wind load (mph)	90	90
Tank diameter (feet)	100	100

Table 5-8 summarizes the life cycle analysis for each type of cover. The following assumptions are made for this analysis: (1) cost per kWh = $0.10; (2) discount rate = 3 percent; and (3) inflation was not considered.

Table 5-8 Digester 4 Cover Life Cycle Analysis

	Steel Cover	Membrane Cover
Capital Cost		
• Number of units	1	1
• Gas storage capacity (cubic feet)[1]	113,631	261,717
• Cost per unit	$797,356	$485,548
• Total capital cost[2]	$797,356	$485,548
• Total construction cost[3]	$2,000,000	$1,100,000
Operational Cost		
• Energy used per unit (watts)		3,000
• Operation cost per year[4]	$0	$2,600
Maintenance Cost Per Year	$37,000 [5]	$2,000
Replacement Cost		
• Average life (years)	30	10
• Replacement cost per unit	N/A	$485,548
• Replacement construction cost	N/A	$2,200,000
Present Worth[6,7]	$3,200,000	$2,700,000
Present Worth/Cubic Feet of Storage	$28.16	$10.32

(1) Based on Ovivo models.
(2) Cost of cover only.
(3) Includes cover, piping, blowers, general conditions, overhead and profit, and 25 percent contingency.
(4) Cost per kWh: $0.10
(5) This is the cost of recoating the entire cover ($300,000) every 10 years adjusted to an annual amount.
(6) Discount rate, i: 0.03
(7) Life cycle, years: 30.

As shown in the life cycle cost analysis, the membrane cover has a lower initial capital cost, construction cost, and overall lower life cycle cost (present-worth) than the steel cover. It has an additional advantage of greater gas storage (twice the capacity, in this case). When considering the present-worth price per cubic foot of gas storage, the membrane cover is more cost effective than the steel cover. Neither cover has an operational advantage compared to the other. However, the membrane covers operate at a lower pressure, which may require the addition of booster pumps if other equipment (i.e., boilers) is designed to operate at a higher pressure. Based on this analysis, it appears that a membrane cover may be more economical than a steel cover. Further evaluation should be done prior to Phase 2 before making the decision to replace with a steel/fiberglass cover or a membrane cover.

In comparison to replacing the cover, rehabilitating the existing cover and center column (sandblasting and recoating) would cost approximately $460,000 total construction cost including General Conditions, overhead and profit, and contingency.

To summarize, a list of Phase 2 recommended repairs for the digester is given below:

1. Replace or rehabilitate cover.
2. Recoat interior digester walls.
3. Recoat pipes in pipe chase.

4. Rehabilitate corroded wall sleeve on 14-inch pipe in pipe chase.
5. Seal leaky joints in pipe chase.
6. Repair cracks in pilasters/parapet extensions.
7. Repair spalls in pilasters/parapet extensions.
8. Recoat exposed surface of pilasters with an elastomeric protective coating.

Table 5-9 lists the recommended Phase 2 repairs and associated costs for the secondary digester.

5.4 Remaining Useful Life

Table 5-10 lists the estimated remaining life of items identified as Phase 2 and Phase 3 improvements. The remaining useful life was based on equipment age and condition. An expected useful life of 20 years is typical for equipment with moving parts, and 30 years is typical for equipment with no moving parts. The remaining useful life for roof insulation was based on a typical useful life of 20 years. If the condition of the equipment was better or worse than average for the age, this resulted in an increase or decrease in remaining useful life, respectively.

5.5 Other Potential Improvements

5.5.1 Primary Sludge Degritting

One of the challenges of maintaining an efficient anaerobic digestion process is keeping grit out of the digesters. Even with the most efficient mixing system, grit will still settle at the bottom of the digester, reducing digester capacity. Further evaluation of grit removal upstream of the digesters should be considered. One potential location to remove grit is after the primary clarifiers with primary sludge degritting equipment. It is recommended that consideration be given to primary sludge degritting as a future WWTP upgrade. This improvement will significantly decrease grit accumulation in the digesters and result in more efficient digester performance, consistent gas production, and energy recovery.

5.5.2 Mixing Ability in Digester 4

Another optional upgrade is to provide mixing capability to the secondary digester so the secondary digester can be used for standby digester capacity when needed. This option includes the addition of a pumped mixing system in Digester 4 and would cost approximately $1,000,000. An example of the technology used for the pumped mixing system would be the Vaughan Rotamix system, which consists of floor-mounted nozzles inside the digester, fed by a chopper pump. This feature allows the secondary digester to serve as a standby primary digester in the event one of the primary digesters is taken out of service.

5.5.3 Co-Digestion

Biogas production can be further enhanced by adding fats, oils and grease (FOG) directly to the digester. FOG is an energy-rich food source readily biodegradable in anaerobic systems and can be collected from local restaurants and received at Metro. An engineering study should be performed to assess the feasibility of co-digestion at the Metro plant.

5.5.4 Additional Cogeneration

The improvements made during this project will/have resulted in greater gas production. With additional gas production, there may be adequate fuel produced to warrant a second cogeneration unit. A study should be performed to evaluate the feasibility/potential of adding a second unit.

Both co-digestion and cogeneration are associated with energy efficiency improvements and would potentially be applicable to NYSERDA funding for both the study/feasibility and project phases. Up to 50 percent funding by NYSERDA is possible.

Table 5-1 Phase 2 Recommended Repairs – Digester Control House

Equipment/Material	Quantity	Material Cost	Installed Cost	Approximate Age (Years)
Replacement of sludge heat exchangers	3	$225,000	$320,000	35
Replacement of sludge recirculation pumps	3	$120,000	$160,000	10
Replacement of hot water heat exchangers	3	$75,000	$110,000	35
Replacement of condensate pumps and motors	2	$9,000	$13,000	35
Replacement of 8-inch carbon steel gas piping with stainless steel	90 LF	$70,000	$100,000	--
Replacement of other gas mixing system valves[(1)]	Multiple	$106,000	$150,000	20
Replacement of sediment traps	11	$105,000	$130,000	20
Replacement of waste gas burners and ignition system[(2)]	3	$154,000	$210,000	15
Replacement of hot water circulating pumps	3	$24,000	$36,000	35
Replacement of penthouse roof ballast	N/A	$500	$2,000	--
Replacement of glycol system[(3)]	1	$6,300	$10,000	35
Replacement of exterior pipe insulation jacket	All	$7,200	$12,000	--
Miscellaneous painting/patching walls, floors, ceilings	N/A	$4,200	$21,000	--
Replacement of windows	~30	$60,000	$86,000	--
Repair of exterior doors	~3	$500	$3,000	--
Relocate condensate receiver vent	1	$200	$1,000	--
Repair leaking wall penetrations for 2-inch gas feed pipe in basement (material cost = mostly labor)	9	$2,000	$2,000	--
Replace main roof[(4)]	1,600 SF	$25	$40,0000	--
Miscellaneous mechanical[(5)]	1	N/A	$100,000	--
Electrical			$150,000	--
Demolition			$100,000	--
Subtotal General Conditions (8%) Mobilization (5%) Construction Contingency (25%) Contractor's Overhead and Profit (20%)			$1,700,000 $140,000 $85,000 $425,000 $340,000	
Total Construction Cost Engineering and Administrative (20%)			**$2,700,000** $500,000	

Table 5-1 (continued)

Equipment/Material	Quantity	Material Cost	Installed Cost	Approximate Age (Years)
TOTAL PROJECT COST (2012) (ENR 9308)			**$3,200,000**	
TOTAL PROJECT COST AT MIDPOINT OF CONSTRUCTION (2018) (ENR 10,816) (6)			**$3,800,000**	

(1) This item includes replacement of: (a) five 8-inch low pressure check valves; (b) three pressure relief flame trap assemblies (on waste gas burner lines); and (c) six flame checks
(2) Includes burners and ignition system, and electronic controls package.
(3) Installation of heat tracing is proposed to replace the glycol system.
(4) Material cost includes labor.
(5) Includes replacement of overflow box piping and interior grating on first floor.
(6) Projected ENR Cost Index.

Table 5-3 Digester 1, Phase 2 Recommendations

Phase 2 Repairs	Quantity	Unit	Material Unit Price	Labor	Total Cost
Replace insulated roof	11,000	LS	$5	Included	$60,000
Roof silicone coating	1	Each	$40,000	Included	$40,000
Recoat interior roof and walls	20,000	SF	$10	Included	$200,000
Recoat mixing guns/bubble generators	6,000	SF	$20	Included	$120,000
Repair cracks in pilasters	500	LF	$40	Included	$20,000
Repair spalls in pilasters and parapet extensions	240	SF	$20	Included	$4,800
Recoat pilasters	1,080	SF	$10	Included	$10,800
Replace sealant at top of tank wall between tank wall and flashing cap	314	LF	$5	Included	$1,600
Replace embedded guardrail posts at top of tanks with surface mount posts and repair spalls	80	Each	$100	Included	$8,000
Seal leaking joints in pipe chase	80	LF	$20	Included	$1,600
Remove sludge from pipe chases	1	LS			Negligible
Subtotal General Conditions (8%) Mobilization (3%) Construction Contingency (25%) Contractor's Overhead and Profit (20%)					**$500,000** $40,000 $20,000 $130,000 $100,000
Total Construction Cost Engineering (20%)					**$800,000** $160,000
TOTAL PROJECT COST (2012) (ENR 9308)					**$960,000**
TOTAL PROJECT COST AT MIDPOINT OF CONSTRUCTION (2018) (ENR 10,816)[(1)]					**$1,100,000**

(1) Projected ENR Cost Index.

Table 5-4 Digester 2, Phase 2 Recommendations

Phase 2 Repairs	Quantity	Unit	Material Unit Price	Labor	Total Cost
Replace insulated roof	11,000	LS	$5	Included	$60,000
Roof silicone coating	1	Each	$40,000	Included	$40,000
Recoat interior roof and walls	20,000	SF	$10	Included	$200,000
Recoat mixing guns/bubble generators	6,000	SF	$20	Included	$120,000
Repair cracks in pilasters	500	LF	$40	Included	$20,000
Repair spalls in pilasters and parapet extensions	240	SF	$20	Included	$4,800
Recoat pilasters	1,080	SF	$10	Included	$10,800
Replace sealant at top of tank wall between tank wall and flashing cap	314	LF	$5	Included	$1,600
Replace embedded guardrail posts at top of tanks with surface mount posts and repair spalls	80	Each	$100	Included	$8,000
Seal leaking joints in pipe chase	80	LF	$20	Included	$1,600
Replace damaged or missing pipe insulation in pipe chase	10	LF	$150		$1,500
Remove sludge from pipe chases	1	LS			Negligible
Subtotal General Conditions (8%) Mobilization (3%) Construction Contingency (25%) Contractor's Overhead and Profit (20%)					**$500,000** $40,000 $20,000 $130,000 $100,000
Total Construction Cost Engineering (20%)					**$800,000** $160,000
TOTAL PROJECT COST (2012) (ENR 9308)					**$960,000**
TOTAL PROJECT COST AT MIDPOINT OF CONSTRUCTION (2018) (ENR 10,816)[(1)]					**$1,100,000**

(1) Projected ENR Cost Index.

Table 5-5 Digester 3, Phase 2 Recommendations

Phase 2 Repairs	Quantity	Unit	Material Unit Price	Labor	Total Cost
Replace insulated roof	11,000	LS	$5	Included	$60,000
Roof silicone coating	1	Each	$40,000	Included	$40,000
Recoat interior roof and walls	20,000	SF	$10	Included	$200,000
Recoat mixing guns/bubble generators	6,000	SF	$20	Included	$120,000
Repair cracks in pilasters	500	LF	$40	Included	$20,000
Repair spalls in pilasters and parapet extensions	240	SF	$20	Included	$4,800
Recoat pilasters	1,080	SF	$10	Included	$10,800
Replace embedded guardrail posts at top of tanks with surface mount posts and repair spalls	80	Each	$100	Included	$8,000
Seal leaking joints in pipe chase	80	LF	$20	Included	$1,600
Remove sludge from pipe chases	1	LS			Negligible
Pressure injection grouting of slab/wall interface	315	LF	100	Included	31,500
Remove failing epoxy coating of wall/slab interface and patch with a polymer modified cementitious repair material	80	SF	$18	Included	$1,440
Clean out vertical construction joints and install new backer rod and polyurethane sealant	280	LF	$10	Included	$2,800
Sandblast and recoat roof stairs and platform	1	LS			$10,000
Replace sludge feed pipes	200	LF	$40	Included	$8,000
Subtotal General Conditions (8%) Mobilization (3%) Construction Contingency (25%) Contractor's Overhead and Profit (20%)					**$500,000** $40,000 $20,000 $130,000 $100,000
Total Construction Cost Engineering (20%)					**$800,000** $160,000
TOTAL PROJECT COST (2012) (ENR 9308)					**$960,000**
TOTAL PROJECT COST AT MIDPOINT OF CONSTRUCTION (2018) (ENR 10,816)[(1)]					**$1,100,000**

(1) Projected ENR Cost Index.

Table 5-9 Phase 2 Repairs – Secondary Digester

Phase 2 Repairs	Quantity	Unit	Material Unit Price	Labor	Cost
Repair joints in Digester 4 pipe chase that are leaking groundwater	80	LF	$20	Included	$1,600
Rehabilitate corroded wall sleeve on 14-inch pipe in pipe chase	1	LS			$500
Coating pipes in the chase	1	LS			$10,000
Replace digester cover [1]	1	LS	$800,000	$400,000	$1,200,000
Recoat digester walls	10,000	SF	$10	Included	$100,000
Repair spalled and cracked pilasters/parapet extensions	1,000	SF	$20	Included	$20,000
Recoat exposed surfaces of pilasters/parapet extensions	1,000	SF	$20	Included	$10,000
Subtotal					**$1,300,000**
General Conditions (8%)					$100,000
Mobilization (3%)					$40,000
Construction Contingency (25%)					$325,000
Contractors Overhead and Profit (20%)					$260,000
Total Construction Cost					**$2,000,000**
Engineering and Administrative (20%)					$400,000
TOTAL PROJECT COST (2012) (ENR 9308)					**$2,400,000**
TOTAL PROJECT COST AT MIDPOINT OF CONSTRUCTION (2018) (ENR 10,816)[2]					**$2,800,000**

(1) Based on steel cover. If rehabilitation is possible, this line item total would be $300,000.
(2) Projected ENR Cost Index.

Table 5-10 Remaining Useful Life of Items Identified as in Need of Repair or Replacement in Phases 2 and 3

Equipment/Material	Quantity	Approximate Age (Years)	Remaining Useful Life (Years)[1]
Digester Control House			
Sludge heat exchangers	3	40	0
Sludge recirculation pumps	3	12	8
Hot water heat exchangers	3	40	0
Condensate pumps and motor	2	40	0
Gas compressors	5	21	0
Sediment traps	11	21	10
Waste gas burners	3	16	4
Hot water circulating pumps	3	40	0
Glycol system	1	40	0
Exterior pipe insulation jacket	All	40	5
Sludge transfer pumps	2	12	8
Sump pumps	2	24	0
Digester 1			
Epoxy coating on tank interior	NA	Unknown	0
Roof insulation	NA	17	3
Mixing guns[2]	12	21	10
Digester 2			
Epoxy coating on tank interior	NA	Unknown	0
Roof insulation	NA	17	3
Mixing guns[2]	12	21	10
Gas feed pipe supports (after recoating)	~75	21	10
Damaged pipe insulation in chase	10 LF	21	0
Digester 3			
Epoxy coating on tank interior	NA	Unknown	0
Roof insulation	NA	17	3
Mixing guns[2]	12	21	10
Digester 4			
Floating cover	1	50	10

(1) From 2013.
(2) Recoating mixing guns will increase useful life.

6 Total Cost – Phase 2 Recommendations

Table 6-1 summarizes the total costs for Phase 2 repair recommendations of the digester complex.

Table 6-1 Total Phase 2 Costs(1)

Structure	Total Cost (2012)(2)	Total Cost (2018)(3)
Digester Control House	$3,200,000	$3,800,000
Digester 1	$960,000	$1,100,000
Digester 2	$960,000	$1,100,000
Digester 3	$960,000	$1,100,000
Secondary digesters	$2,400,000	$2,800,000
Total Phase 2 Cost (rounded)	**$8,500,000**	**$9,900,000**
Optional mixing system, Digester No. 4	$1,000,000	$1,200,000

(1) Does not include compressor replacement project.
(2) ENR Cost Index.
(3) Projected ENR Cost Index.

The additional costs associated with removing, disposing, and cleaning the digesters would need to be added to the above values to determine the true total cost.

Appendices

Appendix A

Interim Inspection Report, Digester 1

Digester No. 1 Exterior Tank Repair Memo (September 26, 2011)

Sika Memo (August 23, 2011)

Digester No. 1 Roof Drain Memo (May 16, 2011)

MEMORANDUM

INTERIM INSPECTION REPORT (Revised January 31, 2013)
DIGESTER NO. 1
METRO SYRACUSE WWTP DIGESTER CLEANING AND MISCELLANEOUS REPAIRS
ONONDAGA COUNTY, NEW YORK

OBJECTIVE

The objective of this report is to summarize the Digester No. 1 observation findings and to provide recommendations for repairs that could be completed while the digester is out of service and those which may be necessary for Phase 2 digester improvements.

BACKGROUND

Digester No. 1 is one of four anaerobic digesters at the Syracuse Metropolitan WWTP. The digester is 100 feet in diameter with 27.5-foot high walls and a liquid capacity of approximately 1.8 million gallons. Digester No. 1 is a primary digester of concrete construction with a concrete dome covered with an insulated roofing system (composed of insulation covered with a hard shell material). Large sections of the exterior walls are covered with vertical metal siding between the 12 exposed 4-foot wide concrete pilasters that are evenly spaced around the circumference of the tank. The digester has been in service for over 50 years.

OBSERVATIONS

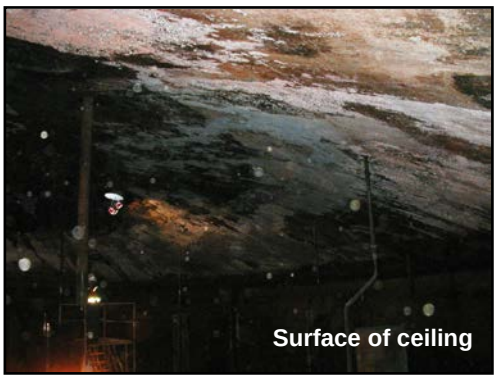
The interior and exterior observation of Digester No. 1 was completed on March 1, 2011 using still photographs. The concrete structure, roofing system, piping and supports, and mixing equipment were observed. The condition assessment and associated repair recommendations are described in the following paragraphs.

STRUCTURAL

Interior

The interior surfaces of the concrete floor and approximately the bottom two-thirds of the wall had been cleaned off and pressure washed. The top third of the wall had a thick coating of solids that had not been removed. The underside of the concrete roof (ceiling) had not been cleaned off and solids still coated much of the surface. Scaffolding located along the outside wall provided access to a portion of the ceiling for structural assessment.


Coating of solids


Surface of ceiling

The interior surfaces of the concrete wall, roof, and floor appeared to be in good condition. The concrete appeared to be structurally sound with no material loss or damage. The only noticeable exception is an approximate 2-inch deep, 1 square foot spalled area in the slab that does not appear to expose any rebar (refer to photo). This spall does not appear to have any structural significance; however, we do recommend repairing the spall while the digester is out of service. This work will be covered under Unit Price Payment Item 5. The top third of the wall could not be inspected because of the solids coating.

Exposed concrete wall

Spall in base slab

There appears to be a coal tar epoxy coating on the wall and base slab. Approximately 50 percent of the coating remains. Areas of the coating on the wall appeared to have bonding failure and broke off when tapped on. The coating on the base slab appeared to be in good condition with no apparent bonding issue. We recommend recoating the entire interior digester walls and roof with high build epoxy coating (such as Sikagard 62). The estimated time to complete this recoat is two months. Due to the cost and time required to complete this work, we recommend that this recoating be completed as a Phase 2 improvement.

Wall coating removed from pressure washing

Wall coating removed from pressure washing

Exterior

The insulated roof appeared to be in fair condition, with different areas of the hard shell broken through. Some of these broken shell areas appear to have been previously repaired. It is estimated that less than 5 percent of the roof area has this type of damage. We recommend patching the broken shell

areas. This work would require a modification. During Phase 2 of the digester repairs, we recommend all of the insulation on the roof be replaced.


Damaged area of roof

The metal siding appears to be in fair condition with some fading of the color and damage along the bottom edge. The damage along the bottom edge is assumed to have been caused by lawnmowing or some other equipment.

The exposed pilasters appeared to have stucco finish. Many of the surfaces are dark stained, and some areas are showing horizontal cracking evenly spaced from the top to approximately halfway down the pilaster. The stucco-type coating needs to be repaired in several different areas. Along the top of every pilaster, there is a significant horizontal crack which may indicate more than just cracking in the stucco-type coating. We recommend repairing the cracked concrete pilasters. This repair work can be completed as a Phase 1 repair by the construction contractor.

One of the pilasters has significant damage at the top where a drain pipe penetrates through it. We recommend repairing this spalled area.

The exterior surfaces of the concrete walls and roof could not be observed because of the metal siding and roofing material, respectively.


Typical pilaster cracking


Spalled area in pilaster

MECHANICAL

Sludge Withdrawal Pipes

There are two 6-inch diameter ductile iron sludge withdrawal pipes in Digester No. 1. They terminate at the center of the digester and are routed along the bottom slope of the floor. The pipes are supported by concrete block. Both pipes and all supports appear to be in good condition. No recommendations are made at this time for corrective repairs to the sludge withdrawal pipes or supports.


Sludge withdrawal pipe


Sludge withdrawal concrete block supports

Sludge Feed Pipes

There are two 8-inch diameter ductile iron sludge feed pipes in Digester No. 1 which terminate at the center of the digester. There is a low feed and a high feed as shown in the photo. The low feed is just off the floor and the high feed is about 3 feet above. The pipes are supported by concrete block with wood framing for the low pipe. The low sludge feed pipe appeared to be in good condition. No recommendations are made at this time for corrective repairs to the low sludge feed pipe.

The high sludge feed pipe has significant internal buildup of scale and the working diameter of the pipe has been greatly reduced. We recommend replacing the high sludge feed pipe back to the last isolation valve in the Digester Control House. The new pipe will be 8-inch flanged ductile iron pipe with a plain end discharge. The approximate length of pipe to be replaced is 75 feet. We recommend the new sludge feed pipe match the existing layout and the existing supports be reused. This work would fall under Unit Price Payment Item 8.


Sludge feed pipes discharge


High sludge feed pipe showing corrosion


Sludge feed and withdrawal pipe wall connections


Sludge feed pipe supports

The concrete supports appeared to be in good condition. No recommendations are made at this time for corrective repairs to the sludge feed pipe supports.

Sludge Recirculation Suction Elbow

Each primary digester is equipped with a single 8-inch diameter sludge recirculation suction (ductile iron) elbow. The recirculation suction pipe enters the digester and elbows up. The intake of the elbow is approximately 10 feet above the bottom of the digester wall.

The recirculation elbow appeared to be in good condition, although it was flooded with liquid. No recommendations are made at this time for corrective repairs to the sludge recirculation elbow. However, the Contractor is required to remove all liquid from the digester under the lump sum work, and all sludge pipes should be flushed and drained, including the recirculation suction line.


Sludge recirculation suction elbow


Sludge recirculation suction elbow

Sludge Low Supernatant Overflow Elbow

Each primary digester is equipped with a single 8-inch diameter sludge low supernatant overflow (ductile iron) elbow. The low supernatant overflow pipe enters the digester and elbows up. The intake of the elbow is approximately 22 feet above the bottom of the digester wall.

The low supernatant overflow elbow appeared to be in good condition. No recommendations are made at this time for corrective repairs to the low supernatant overflow elbow.


Sludge low supernatant overflow elbow

Sludge High Supernatant Overflow Elbow

Each primary digester is equipped with a single 8-inch diameter sludge high supernatant overflow ductile iron elbow. The high supernatant overflow pipe enters the digester and elbows up. The intake of the elbow is approximately 26 feet above the bottom of the digester wall.

The high supernatant overflow elbow appeared to be in good condition. However, it was plugged with sludge/scum/grit accumulation. We recommend the Contractor flush and drain the entire sludge high supernatant overflow line. This is required in the lump sum work of the project.


Sludge high supernatant overflow elbow

Digester Gas Feed Pipes

There are 12, 2-inch diameter stainless steel digester gas feed pipes in each primary digester which supply digester gas to 12 mixing guns. Three mixing guns are located in an inner ring and nine mixing guns are located in an outer ring. The 2-inch stainless steel gas pipes discharge at each mixing gun into a "bubble generator" box. The pipes are supported by carbon steel pipe supports.

The stainless steel pipes appeared to be in good condition. When attempting to flush each gas pipe, it was discovered that three gas feed pipes were clogged at the elbow just before the entrance to the "bubble generator." All 2-inch stainless gas pipes are required to be free and clean of grit for proper operation of the mixing system. We recommend the clogged pipes be snaked and flushed clean. This work will require a modification.

The pipe supports appeared to be in poor condition. All showed corrosion, and on some of the supports, the bottom of the steel pipe was completely corroded away. We recommend replacing all gas pipe supports with stainless steel supports and hardware. The pipe supports will be replaced in kind, and all replacement hardware and plates will be 316 stainless steel. The existing U-bolts holding the pipes are stainless and can be reused if possible, as is the case with the existing anchor bolts at the baseplate. The supports should be replaced with Type 304 Schedule 40 stainless steel.


Gas feed piping and supports

The estimated quantity to be replaced is 65 pipe supports, each approximately 7 to 10 feet tall. A modification will be required to complete this work. We recommend obtaining a proposal from the contractor to replace all of the pipe supports. If the price exceeds the budget of the project, an alternative approach is to replace only the most severely corroded pipe supports (those that have corroded away at the bottom), and replace the remaining as part of Phase 2.


Gas feed pipe support - corroded


Gas feed pipes wall connections

Digester Gas Mixing Guns

The mixing guns appear to be in fair condition; however, much of the coating has worn off of the mixing gun tube. The coast of recoating the mixing guns is estimated to be $120,000. Due to the time and cost to recoat the mixing guns, it is recommended this work be completed during Phase 2.


Digester gas mixing gun


Digester gas mixing gun

Coating has also worn off of the carbon steel bubble generators. In Phase 2, it is recommended to either recoat the bubble generators or replace with stainless steel.


Bubble generator and bottom of mixing gun

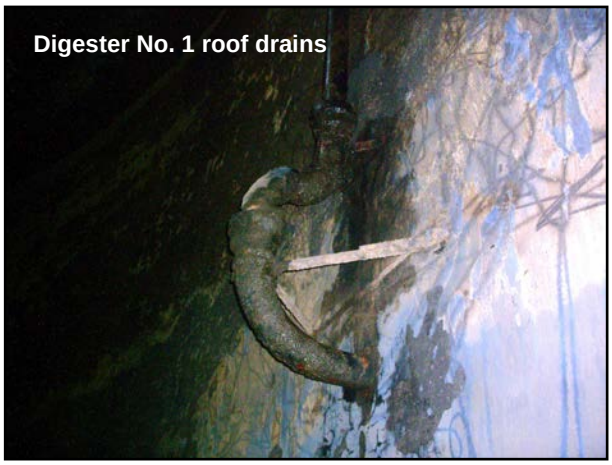

Top of mixing gun shaft

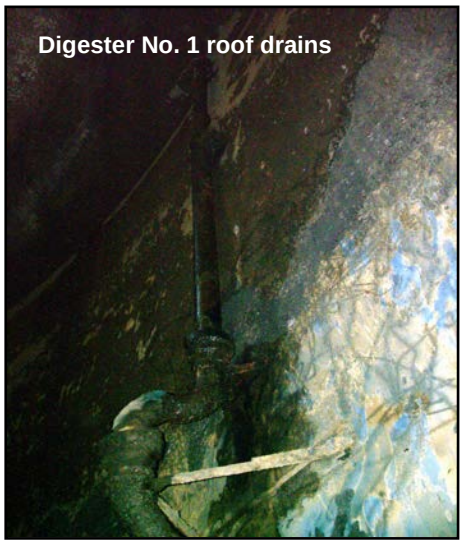
Roof Drains

Each primary digester is equipped with roof drains. The roof drains are located on the inside wall of the digester and discharge through the digester wall below grade and drain to a manhole outside of the digester.


Residue over roof drain

The roof drains are believed to be cast iron and original with the digester. They appeared to be leaking. We also observed that the inlets of the roof drains on the exterior of the digester cover were covered with residue. The drain pipes could be plugged and this could be the reason for the leaking. We recommend the contractor clear the drains of this residue. Once the residue is cleared and the drains can be seen, we recommend the drains be flushed with water and verify they are properly draining to the manhole. A modification will be required to complete this work.


Digester No. 1 roof drains


Digester No. 1 roof drains

Miscellaneous Digester Cleaning

During the inspection, we noticed several piles of debris (broken concrete, etc.) and deposits of sludge or grit. This debris has potential to clog pipes if not removed. We recommend clearing all of the remaining debris from the digester. This work is covered under the lump sum.

Digester No. 1 Pipe Chase

The pipe chase between the Digester Control House and Digester No. 1 was also observed. The condition of the pipes could not be determined due to the submersible insulation wrapped around all of the pipes. The submersible insulation appeared to be in good condition. It is believed the submersible insulation is adequately protecting the pipes. The pipe supports are all stainless steel and appeared to be in good condition. No recommendations are made at this time for corrective repairs to the Digester No. 1 pipe chase, other than the replacement of the sludge feed pipe previously noted.

Repair Recommendations

Short-term repair recommendations are as follows:

1. Patch spalled area in concrete floor. This work will be covered under Unit Price Payment Item 5.
2. Patch insulation on roof. This work would require a modification.
3. Repair cracked concrete of exterior pilasters. The work will be covered under Unit Price Payment Item 6.
4. Repair spalled pilaster. The work will be covered under Unit Price Payment Item 5.
5. Replace high sludge feed pipe. This work will be covered under Unit Price Payment Item 8.
6. Flush and drain the sludge recirculation line. This work is part of the lump sum.
7. Flush and drain the sludge high supernatant overflow line. This work is part of the lump sum.
8. Unclog and flush three plugged stainless steel gas feed lines. This work would require a modification.
9. Replace gas feed pipe supports. This work would require a modification.
10. Clean the residue off of the inlet and flush the roof drains. This work would require a modification.
11. Remove all foreign debris and remaining sludge from the digester.

Long-term recommendations (Phase 2) for Digester No. 1 include the following:

1. Replace the insulation on the roof.
2. Recoat interior roof and walls.

3. Recoat mixing guns.

4. Recoat or replace carbon steel bubble generators with stainless steel.

All repairs shall be made in accordance with the contract specifications and the manufacturer's specifications. Table 1 is a cost estimate of the short-term repairs recommended for Digester No. 1.

TABLE 1

PHASE 1
REPAIR RECOMMENDATIONS COST ESTIMATE

Repair	Quantity	Unit	Payment Item No.	Material Unit Price[(1)]	Labor	Total Cost
Patch spalled concrete floor	1	SF	5	$18	NA	$18
Patch insulated roof	10	SF	Modification	$5	$20	$250
Repair cracks in pilasters	480	LF	6	$40	NA	$19,200
Repair spall in pilaster	1	SF	5	$18	NA	$18
Replace high sludge feed pipe.	75	LF	8	$37	NA	$2,784
Flush and drain the sludge recirculation line.	1	LS	Lump Sum	--	--	--
Flush and drain the sludge high supernatant overflow line.	1	LS	Lump Sum	--	--	--
Unclog and flush three plugged stainless gas feed lines.	3	EA	Modification	--	$120	$360
Replace gas feed pipe supports.	65	EA	Modification	$780	$240	$66,300
Clean the residue off of the inlet and flush the roof drains.	1	LS	Modification	--	$240	$240
Remove all foreign debris and remaining sludge from the digester	1	LS	Lump Sum	--	--	--
SUBTOTAL Construction Contingency (5%) Contractor's Overhead and Profit (20%)						**$89,175** $4,500 $17,835
TOTAL CONSTRUCTION COST (rounded)						**$112,000**

(1) Unit price based on contractor's bid.

TABLE 2

PHASE 2
RECOMMENDATIONS

Repair	Quantity	Unit	Material Unit Price[(1)]	Labor	Total Cost
Recoat interior roof and walls	20,000	SF	$9	Included	$180,000
Replace insulted roof	11,000	LS	$5	$20	$275,000
Replace mixing guns/bubble generators	6,000	SF	$20	Included	$120,000
SUBTOTAL Construction Contingency (5%) Contractor's Overhead and Profit (20%)					**$575,000** $30,000 $115,000
TOTAL CONSTRUCTION COST					**$700,000**

MEMORANDUM

September 26, 2011

To	Jeanne Powers - OCDWEP		
Copy to	Edmund Feyh - OCDWEP Daniel Jean - OCDWEP James Renk - OCDWEP Paul McInerney - OCDWEP Bruce Munn - GHD Chris Kwasniewski - GHD		
From	Edward Pepe	Tel	315-679-5800
Subject	Digester No. 1 Exterior Tank Repair Recommendations Metro Syracuse WWTP Digester Cleaning and Miscellaneous Repairs Onondaga County, New York	Job No.	8614054.0

This memorandum supplements the Interim Inspection Report for Digester No. 1 and focuses on various exterior tank repairs. The intent of this memorandum is to develop a repair procedure for the exterior repairs of Digester No. 1. The application of these repairs also applies to Digester Nos. 2, 3, and 4. Refer to the attached letter from Sika Corporation for detailed repair procedures using their specific products.

On July 26, 2011, Chris Kwasniewski of GHD met at Onondaga County's Metro WWTP with Vince Garden, Sika Corporation's product representative, to review miscellaneous items requiring repair. At Digester No. 1, the following items were inspected:

- Surface of exposed concrete pilasters along the outside perimeter of the tank.
- Parapet extension of these concrete pilasters above the tank wall (see Photo 1).
- Sealant between the top of the tank wall and the flashing cap over the metal siding (see Photo 1).
- Concrete surface around the inside of the manway opening riser.

In addition to Digester No. 1, GHD also observed leaking around pipe penetrations in the basement wall of the Digester Control House.

As previously identified in the Interim Inspection Report, there are horizontal surface cracks on the top half of some of the pilasters. We recommend cleaning out the cracks with the edge of a grinder wheel to remove any loose material, then sealing the cracks with an elastomeric sealant. This can be completed through construction Contract No. 1 using unit price Payment Item 6. The remaining surface areas of the pilasters should be sounded to identify and remove any potentially loose material. Any of these areas deeper than 1/4 inch should be patched with a polymer-modified patch mortar. Once all the repairs have been completed, we recommend coating the entire surface of the pilasters with an elastomeric protective coating. This can be accomplished by construction Contract No. 1 using unit price Payment Item 11.

GHD Consulting Engineers, LLC One Remington Park Drive Cazenovia NY 13035 USA
T 1 315 679 5800 **F** 1 315 679 5801 **E** cazmail@ghd.com **W** www.ghd.com

The parapet extensions of the concrete pilasters are all consistent with a wide horizontal crack around the entire perimeter of the parapet at the top of the tank wall elevation. These cracks should be repaired with an elastomeric sealant as described above (Payment Item 6). Some of the parapet extensions had spalled areas, most typically where the guardrail posts are embedded into the parapet extension. We recommend temporarily removing the guardrail posts and patching the pockets and spalled areas with a polymer-modified patch mortar. Once all repairs have been completed, we recommend coating the entire surface of the parapet extensions with an elastomeric protective coating (Payment Item 11). In order to prevent future spalling, we recommend reinstalling the guardrail posts using surface mounts with new aluminum top mount brackets anchored into the parapet extensions in lieu of embedding the mounts. This work would have to be completed by a modification to the current construction contract.

The sealant between the top of the tank wall and the flashing cap over the metal siding was cracked at several locations and appears to have exceeded its useful life. This sealant should be removed around the entire perimeter of the tank and replaced with new elastomeric sealant. This would have to be completed by a modification to the current construction contract.

The interior surface of the manway opening riser had various locations with concrete damage which appeared to have resulted in the loss of concrete, with some areas exposing a slight amount of rebar. Due to limited accessibility to these surfaces, the concrete could not be sounded to determine if additional concrete would need to be removed prior to repair. Thus, we recommend the surface of the manhole opening riser be sounded to identify and remove any potentially loose material. Any areas deeper than 1/4 inch should be patched with a polymer-modified patch mortar. Once all repairs have been completed, we recommend coating the entire concrete surface with a polymer-modified, cementitious protective coating. This can be completed through Payment Item Nos. 5 and 11.

In the Digester Control House basement, the wall dividing the Control House and Digester No. 1 pipe chase is leaking groundwater around several pipe penetrations. It was relayed to GHD through the Owner that this was caused by the Contractor during removal of the 2-inch gas piping. This should be corrected by the Contractor after completion of reinstallation of the piping (at no cost to the County). The perimeter of all the pipe penetrations should be repaired with an expandable urethane injection.

Ranking of Repairs in Terms of Importance to Structural Integrity (1 = Highest Priority)

1. Spall from guardrail.
2. Wide horizontal crack at parapet extension.
3. Spalled masonry opening riser.
4. Horizontal surface cracks in pilaster.
5. Cracked sealant.

These repairs can be completed using the existing unit price pay items, Payment Item 5 - Spalled Concrete Repair, Payment Item 6 - Cracked Concrete Repair, and Payment Item 11 - Miscellaneous

Painting/Coating. The repair procedures provided in this memorandum can also apply to the required repairs for Digester Nos. 2, 3, and 4.

A field order will be provided to the Contractor directing him to complete the specified repairs.

Photo 1: Top of Digester No. 1 exterior wall, looking down on parapet extension and sealant along metal siding flashing cap.

Sika Corporation, 201 Polito Ave, Lyndhurst NJ 07071, USA
Tel: 201 933 8800, Fax: 201 933 6225, www.sikausa.com

August 23, 2011 R1

Chris Kwasniewski
GHD Consulting Engineers LLS
One Remington Park Drive
Cazenovia, NY 13035

Subject: Syracuse Metro Treatment Plant

Ref: Outside Digester Tank Renovation

Chris:

As requested, this letter confirms my inspection of the above project pertaining to the repair, patching and coating of pilasters, capstones and control joints regarding the above subject. The following is the background and recommendations of said project:

- Pilasters are constructed of masonry with a parge coat, and currently are severely cracking and spalding. Recommendations for repairs are as follows: Cracks over 1/8" shall be sealed with Sikaflex 1A. Hairline cracks shall be detailed with Sikagard 550W. Areas where masonry has deteriorated to ¼" to 1" shall be removed and patched with Sikatop 123 Plus. Upon completion of repairs, overall coat surface with two (2) coats of Sikagard 550W, color to match.

- Parapet extensions or capstone is constructed of concrete and currently has deteriorated due to the installation of guardrails, cored into the capstone causing a freeze and thaw fracture. Recommendations for repairs – remove all deteriorated concrete and guardrails and reinstall guardrails by surface mounting into the capstone.

- Concrete of capstone repairs – remove all defective concrete, form and pour with Sikaquick 1000 extended with pea stone or hand patch with SikaTop 123 Plus. Following all repairs of capstone, coat all surface with two (2) coats of Sikagard 550W.

- Concrete surface around the inside of the manway opening riser shall be cleaned of all construction debris and residue remove all defective concrete and patch with SikaTop 123 and allow to cure, followed by the application of two (2) coats of SikaTop 144 (a polymer modified cement coating).

- Control joints at the top of the digester tanks along capstones, there is a one (1) inch wide control joint running the length of the perimeter. Control joints have deteriorated and lost adhesion – Cut out all defective caulking, replace backerrod where needed and recaulk with Sikflex 2C NS.

- In areas of the pump house facility, it was noted that concrete around exposed pipes, coming through the pumphouse walls, show signs of deterioration and water is passing through the walls around the pipe in wet seasons – Install ports around the pipe at a 45 degree angle to the pipe. Install SikaSwell S-2 or Sikafix HH which is an expandable urethane grout. Upon completion of injection, remove defective concrete and patch with Sikatop 123 Plus.

If you require any additional information, please feel free to contact my office.

Yours truly,

Vincent Garden
Sika Rep
315-374-0822

REVISED MEMORANDUM

May 16, 2011

To	Jeanne Powers - OCDWEP		
Copy to	Edmund Feyh - OCDWEP Daniel Jean - OCDWEP James Renk - OCDWEP Paul McInerney - OCDWEP Bruce Munn - GHD		
From	Edward Pepe	Tel	315-679-5800
Subject	Digester No. 1 Roof Drains Metro Syracuse WWTP Digester Cleaning and Miscellaneous Repairs Onondaga County, New York	Job No.	8614054.0

This memorandum revises the Roof Drain memorandum dated April 27, 2011.

The roof drains in Digester No. 1 were further examined on April 19, 2011 and May 6, 2011 after the Contractor relocated his scaffolding to allow closer examination. During our initial inspection, the scaffolding was not set up to allow a close inspection of the condition of the drains. The following are the results of our findings and our recommendation.

There are three roof drains for each primary digester. The roof drains are 4-inch diameter cast iron pipe original to the digester. Much of the pipe was still coated with sludge residue making it difficult to observe its original condition. The pipe appears to be in poor condition. The pipe showed signs of pitting and corrosion. Also, one of the roof drains was observed to be leaking during a previous inspection. We inspected the roof drains again on May 6, 2011 to try and determine the point of leakage. We added water to the drain to examine for leaks. During the addition of water, it was evident that the mechanical link seal was leaking. However, there was no leakage observed around the sleeve or pipe joints. Below are photos of the roof drain from May 6, 2011.

Roof Drain Strainer

GHD Consulting Engineers, LLC One Remington Park Drive Cazenovia NY 13035 USA
T 1 315 679 5800 **F** 1 315 679 5801 **E** cazmail@ghd.com **W** www.ghd.com

Interior Roof Drain

Also, the pipe supports examined were broken and are in need of replacement.

We recommend replacing the roof drains, supports and mechanical seals within Digester No. 1, while the digester is out of service. The roof drains should be replaced with extra heavy 4-inch cast iron pipe and fittings with hub and spigot joints and rubber gaskets, in accordance with ASTM A74 and ASTM C564. The pipe should be painted in accordance with the Contract Documents. The supports are broken and should be replaced in kind with 316 SS material, in accordance with the Contract Documents. The new pipe should be connected to the existing pipe near the wall penetration using a coupling. Also, the mechanical seals are leaking and should be replaced.

Once installed, the Contractor shall leak test the new pipe with hydrostatic pressure. The pipe should be leak tested for one 1/2-hour. The section of pipe internal to the digester should be driptight with no signs of leakage. The details of this work are shown on Figure 1 – Roof Drain Modifications.

The placement of the scaffolding did not allow for inspection of the other two roof drains. However, it is assumed that there condition is similar. Therefore, these recommendations are for all three roof drains in Digester 1.

The estimated cost of replacing three sets of roof drains for Digester No. 1 is $15,000. A modification would be required to perform this work.

EJP/kan:dlr

Appendix B

Interim Inspection Report, Digester 2

IDI Field Service Report (June 14, 2012)

MEMORANDUM

INTERIM INSPECTION REPORT
(April 12, 2012, Revised January 31, 2013)
DIGESTER NO. 2
METRO SYRACUSE WWTP DIGESTER CLEANING AND MISCELLANEOUS REPAIRS
ONONDAGA COUNTY, NEW YORK

OBJECTIVE

The objective of this report is to summarize the Digester No. 2 observation findings and to provide recommendations for repairs that could be completed while the digester is out of service and those which may be necessary for Phase 2 digester improvements.

BACKGROUND

Digester No. 2 is one of four anaerobic digesters at the Syracuse Metropolitan WWTP. The digester is 100 feet in diameter with 27.5-foot high walls and a liquid capacity of approximately 1.8 million gallons. Digester No. 2 is a primary digester of concrete construction with a concrete dome covered with an insulated roofing system (composed of insulation covered with a hard shell material). Large sections of the exterior walls are covered with vertical metal siding between the 12 exposed 4-foot wide concrete pilasters that are evenly spaced around the circumference of the tank. The digester has been in service for over 50 years. It is our understanding that the roofing material is about 10 years old.


Digester No. 2

OBSERVATIONS

The interior and exterior observation of Digester No. 2 was completed on April 9, 2012 using still photographs and video. The concrete structure, roofing system, piping and supports, and mixing equipment were observed. The condition assessment and associated repair recommendations are described in the following paragraphs.

STRUCTURAL

Interior

The interior surfaces of the concrete floor and wall had been cleaned off and pressure washed. Scaffolding located along the outside wall provided access to a portion of the ceiling for structural assessment.

The interior surfaces of the concrete wall, roof, and floor appeared to be in good condition. The concrete appeared to be structurally sound with no material loss or damage. The only noticeable exceptions were two approximate 2-inch deep, 1 square foot spalled areas in the slab that do not appear to expose any rebar (refer to photo). One of these spalls is at the base of Cannon Mixer #12; the other is adjacent to the wall near Cannon Mixer #9. These spalls do not appear to have any

structural significance; however, we do recommend repairing them while the digester is out of service. This work will be covered under Unit Price Payment Item 5. On the roof, a crack was observed that appeared to be a cold joint that was created during concrete placement, likely from original construction. We do not believe there is a structural concern with this cold joint.


Concrete floor spall at Mixing Gun #12


Concrete spall adjacent to wall


Cold joint in roof

There appears to be an asphalt urethane coating on the wall. Approximately 75 percent of the coating remains. Areas of the coating on the wall appeared to have bonding failure and broke off when tapped on. We recommend recoating the entire interior digester walls and roof with high build epoxy coating (such as Sikagard 62). The estimated time to complete this recoat is two months. Due to the cost and time required to complete this work, we recommend that this recoating be completed as a Phase 2 improvement. There did not appear to be a coating on the slab or roof.


Wall coating


Wall coating deterioration

Exterior

The insulated roof appeared to be in fair condition, with some minor areas of the hard shell broken through. It is estimated that less than 5 percent of the roof area has this type of damage. The granular material from this shell has accumulated in the gutter along the perimeter of the dome roof. It is suggested that these gutters be cleaned out in order to keep the roof drains from being clogged.


Roof insulation damage

The metal siding appears to be in fair condition with some fading of the color and damage along the bottom edge. The damage along the bottom edge is assumed to have been caused by lawnmowing or some other equipment.

The exposed pilasters appeared to have stucco finish. Many of the surfaces are dark stained, and some areas are showing horizontal cracking on the pilaster face. The stucco-type coating needs to be repaired in several different areas. Along the top of every pilaster (below the parapet extensions), there is a significant horizontal crack which may indicate more than just cracking in the stucco-type coating. We recommend repairing the cracked concrete pilasters. This repair can be completed at any time and thus is considered a Phase 2 repair.

The sealant between the top of the tank wall and the flashing cap over the metal siding was cracked at two locations. This sealant should be removed around the entire perimeter of the tank and replaced with new elastomeric sealant. This would have to be completed by a modification to the current construction contract.

Many of the parapet extensions of the concrete pilasters are consistent with the roofing material being cracked and pushed out, away from the parapets. These cracks are most typically where the guardrail posts are embedded into the parapet extension and are suspected to be caused by spalled areas beneath. We recommend temporarily removing the guardrail posts and patching the pockets and spalled areas with a polymer-modified patch mortar. Once all repairs have been completed, we recommend coating the entire surface of the parapet extensions with an elastomeric protective coating (Payment Item 11). In order to prevent future spalling, we recommend reinstalling the guardrail posts using surface mounts with new aluminum top mount brackets anchored into the parapet extensions in lieu of embedding the mounts. This work can be completed at any time and thus is considered a Phase 2 repair.

The exterior surfaces of the concrete walls and dome roof could not be observed because of the metal siding and roofing material, respectively.

MECHANICAL

Sludge Withdrawal Pipes

There are two 6-inch diameter ductile iron sludge withdrawal pipes in Digester No. 2. They terminate at the center of the digester and are routed along the bottom slope of the floor. The pipes are supported by concrete block. Both pipes and all supports appear to be in fair condition. No recommendations are made at this time for corrective repairs to the sludge withdrawal pipes or supports.

Sludge Feed Pipes

There are two 8-inch diameter ductile iron sludge feed pipes in Digester No. 2 which terminate at the center of the digester. There is a low feed and a high feed as shown in the photo. The low feed is just

off the floor and the high feed is about 3 feet above. The pipes are supported by concrete block with wood framing. Both sludge feed pipes appeared to be in fair condition. No recommendations are made at this time for corrective repairs.

The concrete supports appeared to be in fair condition. No recommendations are made at this time for corrective repairs.

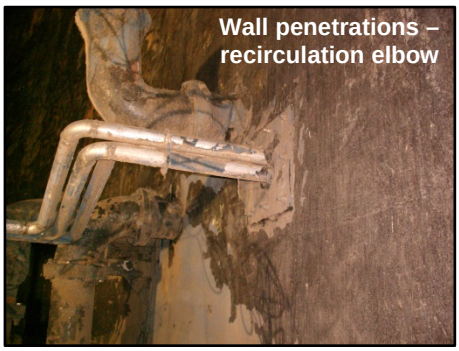

Sludge feed and withdrawal pipes


Sludge feed and withdrawal pipes and supports

Sludge Recirculation Suction Elbow

Each primary digester is equipped with a single 8-inch diameter sludge recirculation suction (ductile iron) elbow. The recirculation suction pipe enters the digester and elbows up. The intake of the elbow is approximately 10 feet above the bottom of the digester wall.

The recirculation elbow appeared to be in fair condition. No recommendations are made at this time for corrective repairs.

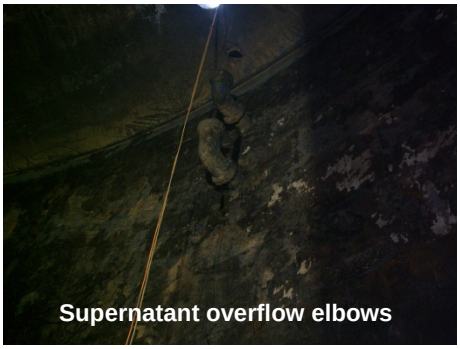

Wall penetrations – recirculation elbow

Sludge Low Supernatant Overflow Elbow

Each primary digester is equipped with a single 8-inch diameter sludge low supernatant overflow (ductile iron) elbow. The low supernatant overflow pipe enters the digester and elbows up. The intake of the elbow is approximately 22 feet above the bottom of the digester wall. The low supernatant overflow elbow appeared to be in fair condition. No recommendations are made at this time for corrective repairs.

Sludge High Supernatant Overflow Elbow

Each primary digester is equipped with a single 8-inch diameter sludge high supernatant overflow ductile iron elbow. The high supernatant overflow pipe enters the digester and elbows up. The intake of the elbow is approximately 26 feet above the bottom of the digester wall. The high supernatant overflow elbow appeared to be in fair condition. No recommendations are made at this time for corrective repairs.


Supernatant overflow elbows

Digester Gas Feed Pipes

There are 12, 2-inch diameter stainless steel digester gas feed pipes in each primary digester which supply digester gas to 12 mixing guns. Three mixing guns are located in an inner ring and nine mixing guns are located in an outer ring. The 2-inch stainless steel gas pipes discharge at each mixing gun into a “bubble generator” box. The pipes are supported by carbon steel pipe supports.

The stainless steel pipes appeared to be in fair condition. When attempting to flush each gas pipe, it was discovered that three gas feed pipes were clogged at the elbow just before the entrance to the “bubble generator.” All 2-inch stainless gas pipes are required to be free and clean of grit for proper operation of the mixing system. We recommend the clogged pipes be snaked and flushed clean.

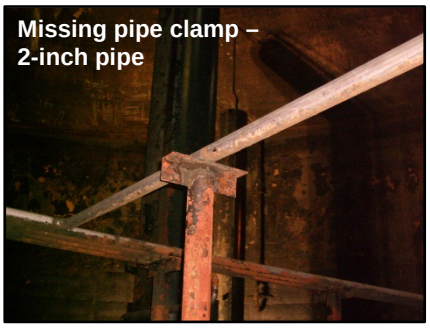
The pipe supports appeared to be in fair condition, although most of the coating protecting the supports has worn off. We believe the carbon steel supports are in sufficient condition to provide adequate support until Phase 2 without any corrective measures. For Phase 2, it is recommended to replace all gas pipe supports with stainless steel supports and hardware. The pipe supports will be replaced in kind, with Type 304 Schedule 40 stainless steel, and all replacement hardware and plates will be 316 stainless steel.

Many of the supports were also missing pipe clamps and screws to restrain the pipe. It is recommended that all pipe supports without clamps or screws be replaced with the appropriate hardware during Phase 1 while the digester is out of service. All replacement clamps or screws should be 316 stainless steel.

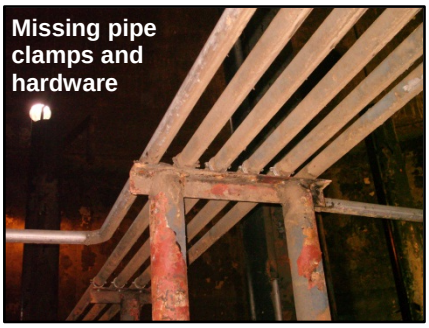

2-inch gas pipe supports: worn coatings


2-inch gas pipe supports: worn coatings


2-inch stainless steel gas pipe wall penetration


Missing pipe clamp – 2-inch pipe


Missing pipe clamps and hardware


Missing pipe clamps and hardware

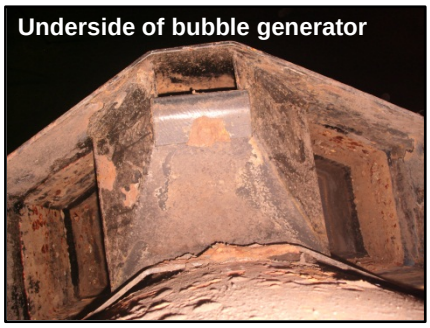
Digester Gas Mixing Guns

This mixing guns appear to be in fair condition; however, much of the coating has worn off of the mixing gun tube. The cost of recoating the mixing guns for Digester No. 2 would be approximately $120,000.

Due to the time and cost required to recoat the mixing guns, it is recommended that this work be completed during Phase 2. Coating has also worn off the carbon steel bubble generators, resulting in some corrosion around the throttle plate openings on some of the mixers. In Phase 2, it is recommended to either recoat the bubble generators or replace with stainless steel. In addition, mats of hair were seen on the inside of the mixing guns and it did not appear they had been cleaned. The inside should be cleaned/power washed as part of the contractual work of this project.


Deteriorated coating on mixing gun

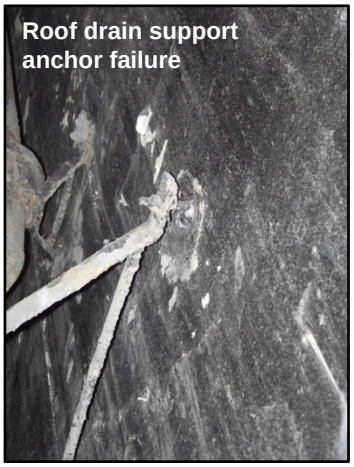

Inside of mixing gun


Underside of bubble generator

Roof Drains

Each primary digester is equipped with three roof drains. For Digester No. 2, the roof drains are mounted on the inside wall of the digester and discharge through the digester wall below grade and drain to a manhole outside of the digester. The roof drains are believed to be cast iron and original with the digester. According to County staff, one of the roof drains leaked inside the digester at a joint, and the other two drains presumably leaked at an unknown location underground before they discharged to the manhole. This was discovered during a hydrostatic pressure test performed by the County and contractor prior to the inspection.


Roof drain


Roof drain support anchor failure

Some of the roof drain support anchors and the coating system on the supports have also failed. The roof drains/supports appear to be in poor condition; however, replacing them while the digester is out of service is not a necessity. Because of this and the budget constraints of the project, we recommend replacing all three roof drains and supports with new cast iron pipe and stainless steel supports in Phase 2.

Digester No. 2 Pipe Chase

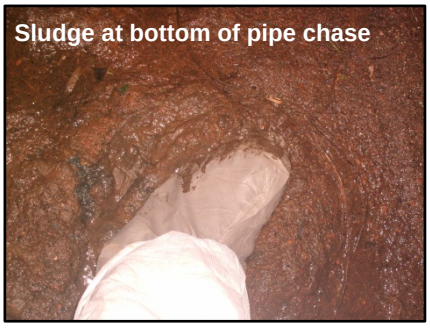
The pipe chase between the Digester Control House and Digester No. 2 was observed. The condition of the pipes could not be determined due to the submersible insulation wrapped around all of the pipes. The insulation appeared to be in poor condition and some has come unwrapped. The insulation that

has come unwrapped should be replaced with a cellular glass insulation, i.e., Pittsburgh Corning Foamglas or equal. Since this repair can be done at any time, it is considered a Phase 2 repair.

Groundwater is leaking in at the joints of the pipe chase. It is recommended to seal these leaky joints. Since this can be done at any time, it is considered a Phase 2 repair.

There appeared to be sludge covering the bottom of the pipe chase. It is recommended that all the sludge sediment in the chase be washed off the pipes and pumped out.

The pipe supports are all stainless steel and appeared to be in good condition. No recommendations are made at this time for corrective repairs to the Digester No. 2 pipe supports.



Included with this report is a CD which contains all of the photos and a video of the Digester No. 2 inspection.

Repair Recommendations

Short-term repair recommendations are as follows:

1. Patch spalled areas in concrete floor. This work will be covered under Unit Price Payment Item 5.

2. Unclog 2-inch gas feed pipes. Contractual work.

3. Replace the missing gas feed pipe support split ring pipe clamps with stainless steel clamps and hardware. This work will require a modification.

4. Clean/power wash the inside of the mixing guns. Contractual work.

5. Repair cracked sealant along flashing cap.

6. Clean out roof perimeter gutter.

Long-term recommendations (Phases 2/3) for Digester No. 2 include the following:

1. Replace the insulation on the roof.
2. Recoat interior roof and walls.
3. Repair cracked concrete of exterior pilasters.
4. Repair spalled parapet extensions.
5. Replace 2-inch gas feed pipe supports with stainless steel.
6. Replace roof drains and supports.
7. Recoat mixing guns.
8. Recoat or replace carbon steel bubble generators with stainless steel.
9. Replace damaged and missing submersible insulation wrap in pipe chase.
10. Repair leaky joints in pipe chase.
11. Clean sludge out of pipe chase.

All repairs shall be made in accordance with the contract specifications and the manufacturer's specifications. Table 1 is a cost estimate of the short-term repairs recommended for Digester No. 2.

TABLE 1

PHASE 1 - REPAIR RECOMMENDATIONS COST ESTIMATE

Repair	Quantity	Unit	Payment Item No.	Material Unit Price(1)	Labor	Total Cost
Patch spalled concrete floor	2	SF	5	$18	NA	$36
Replace 2-inch pipe clamps and hardware for missing material	50	Each	Modification	$25	Included	$1,250
Repair cracked sealants	15	LF	Modification	$20	Included	$300
Clean out roof gutter	1	LS	Modification			$500
SUBTOTAL Construction Contingency (5%) Contractor's Overhead and Profit (20%)						**$2,100** $100 $420
TOTAL CONSTRUCTION COST (rounded)						**$2,600**

(1) Unit price based on contractor's bid if one exists.

TABLE 2

PHASE 2 - RECOMMENDATIONS

Repair	Quantity	Unit	Material Unit Price[(1)]	Labor	Total Cost
Replace insulation on roof	11,000	LS	$5	$20	$275,000
Recoat interior roof and walls	20,000	SF	$10	Included	$220,000
Repair cracks in pilasters	200	LF	$40	Included	$8,000
Repair spalled parapet extensions	240	SF	$18	Included	$4,300
Replace gas feed supports	1	LS			$75,000
Replace roof drains	1	LS			$33,000
Recoat mixing guns/bubble generators	6,000	SF	$20	Included	$120,000
Replace damaged/missing submersible insulation	10	LF	$100	$50	$1,500
Repair leaky joints in pipe chase	80	LF	$10	$10	$1,600
Clean sludge out of pipe chase	1	LS			$1,000
SUBTOTAL Construction Contingency (5%) Contractor's Overhead and Profit (20%)					**$740,000** $40,000 $150,000
TOTAL CONSTRUCTION COST					**$930,000**

INFILCO DEGREMONT INC.
8007 DISCOVERY DRIVE, RICHMOND, VA 23229 USA
P.O. BOX 71390, RICHMOND, VA 23255-1390 USA
TEL 804 756-7600 | FAX 804 756-7643

FIELD SERVICE REPORT

CONTRACT NO.:	**REPORT DATE: June 14, 2012**	
IDI SERVICE REPRESENTATIVE: Sudhakar Viswanathan		
CUSTOMER: WeCare Organics, LLC	**PROJECT NAME: Syracuse Metro WWTP Syracuse, NY**	**CC:**
PHONE NO: (315)952-5771	**EQUIPMENT: Cannon Mixing**	
FAX NO.:		**ACT:**

END USER INFORMATION (Municipality or Company):

INFILCARE

PHYSICAL PLANT LOCATION: Syracuse, NY
MAILING ADDRESS: 650 Hiawatha Blvd West, Syracuse, New York 13204
WEB ADDRESS: http://www.ongov.net/wep/we9001.html

END USER CONTACT(S):

NAME & COMPANY:	TITLE:	PHONE:	FAX:
John Stapleton, WeCare Organics	Project Manager	(315)952-5771	
Drew O'Hara, WeCare Organics		(413)530-4386	

DATE ARRIVED: 06-11 / 10AM	**DATE LEFT SITE: 06-12 / 11AM**	**CONTRACT MANAGER: J. Trobaugh**
CONTACTED PRIOR TO SITE VISIT:		**DATE:** **TIME:**
CONTACTED PRIOR TO LEAVING SITE:		**DATE:** **TIME:**

REASON FOR SERVICE VISIT (Brief Description): Inspect Cannon Mixer installation in digester # 2 during gas piping upgrade, and digester service.

SERVICE PROVIDED / GENERAL REMARKS:

Monday (06-11 @ 10:00)

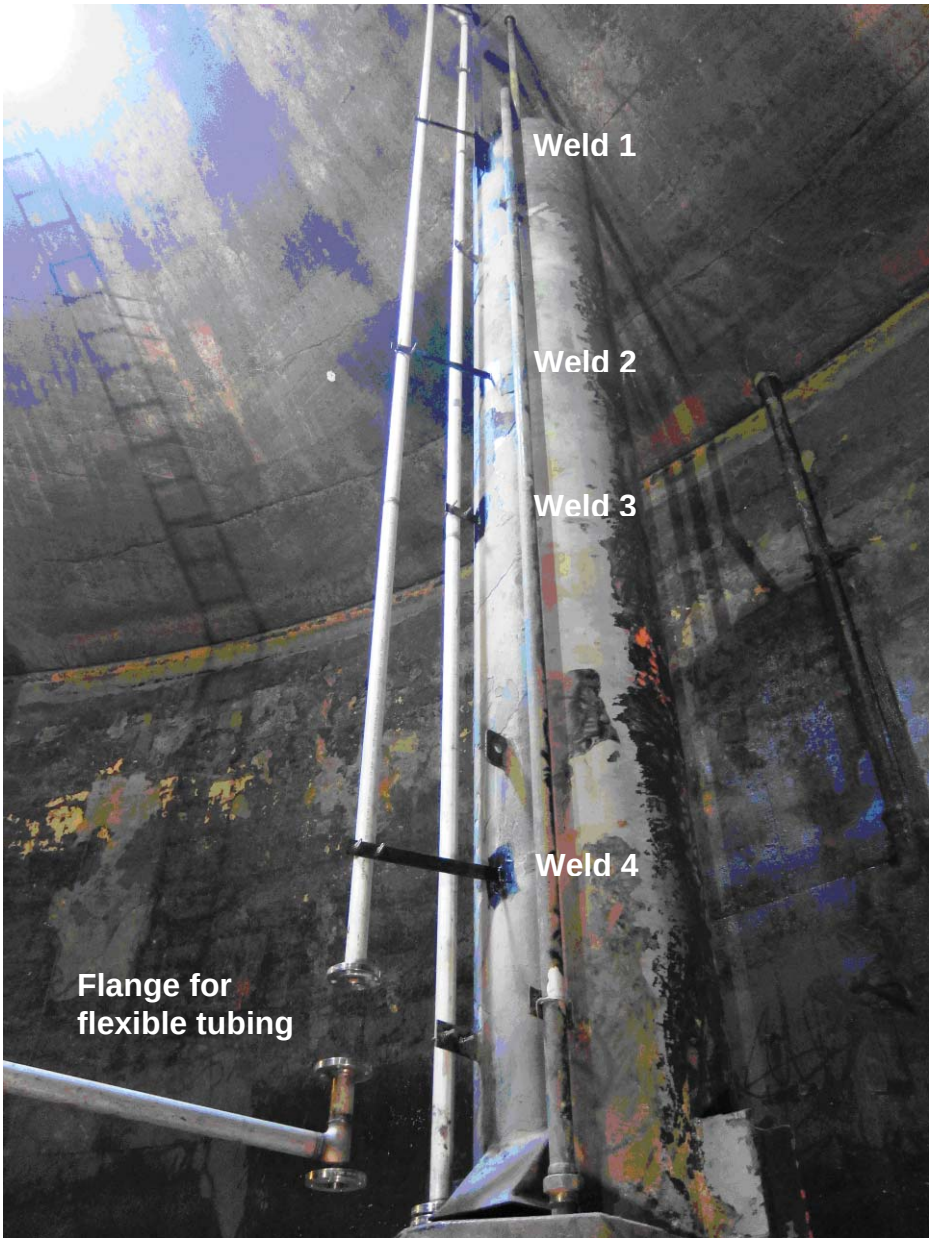
Arrived on site to inspect the Cannon Mixer installation in digester #2. Met with John Stapleton with WeCare Organics at the plant prior to meeting with the rest of the county staff which included (all first names) Jim, Paul, Dan, Jeanne, Ed, and Ed (Pepe) with GHD.

The repairs to the digester #1 were complete and fully operations. Digester #2 was in the process of being modified with internal Hartford Loops for the biogas piping, cleaning of digester and mixers, and regularly scheduled maintenance.

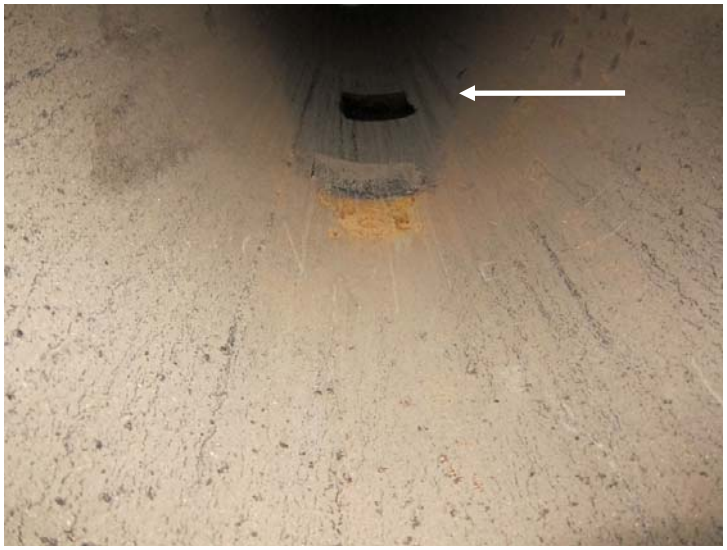
The Cannon Mixers were in good physical shape but the gas piping was not fully installed at the time of the inspection except for mixer #1. Each Cannon Mixers now support one 2-inch Hartford Loop, at least four (4) new welds were made to each mixer, a flexible steel braided gas piping was used to allow for mixer resonance without stressing the rigid Hartford Loop piping.

No minor repairs are required at this time and no follow up inspection is recommended prior to placing the digester into service.

Our recommendations are listed below in no particular order.

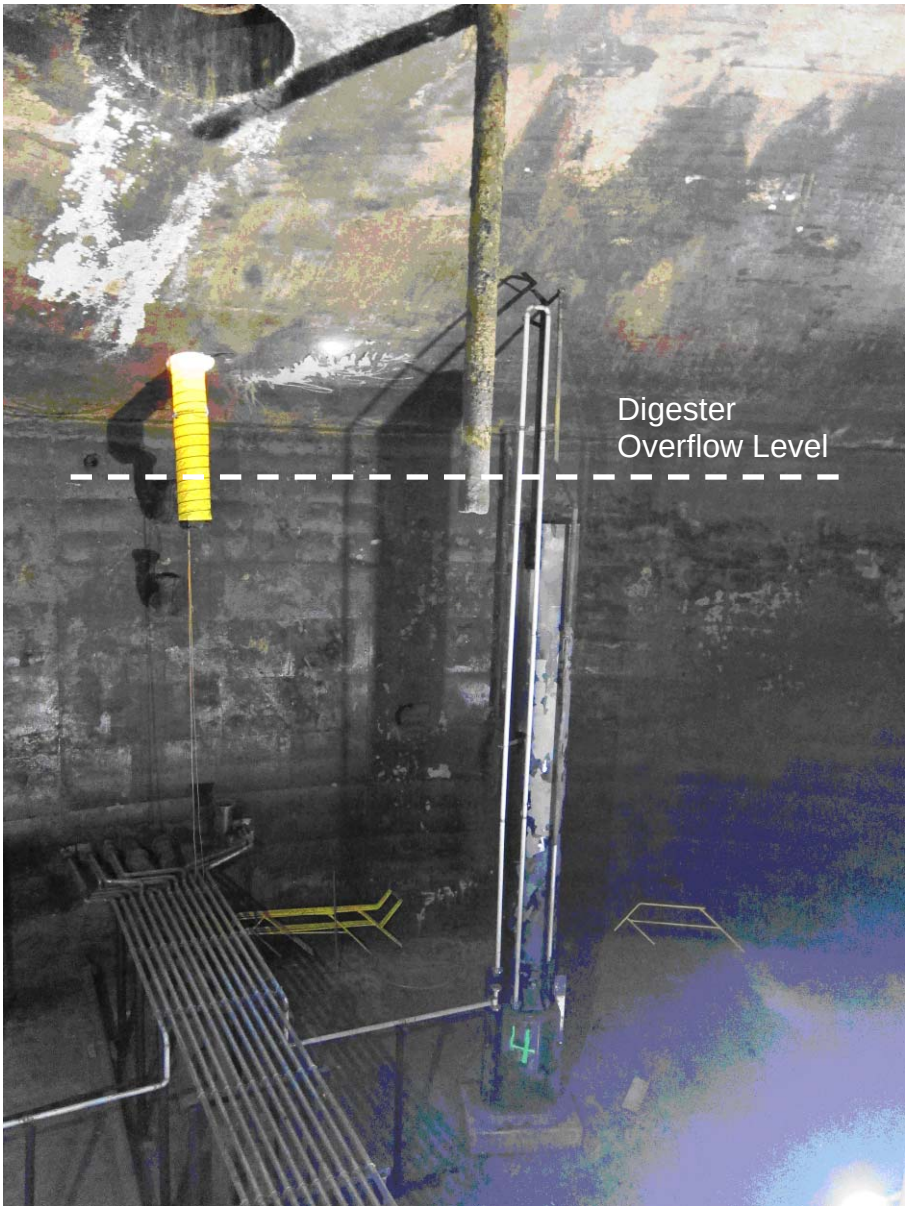


The above picture shows the newly welded Hartford Loop on the existing Cannon Mixer. The end of the Hartford loop includes a steel braided flexible tube connection, see picture below.



The weld inside the mixer was smooth and does not pose any operational issue. See picture above, black paint indicated area welded.

The picture shows the flexible coupling used to prevent the Hartford Loop form stress due to movement of the Cannon Mixers. Each loop would have one of these connections. The bottom of the connection has a flange that would be closed using a blind flange, used only during service to drain and clean the biogas line.



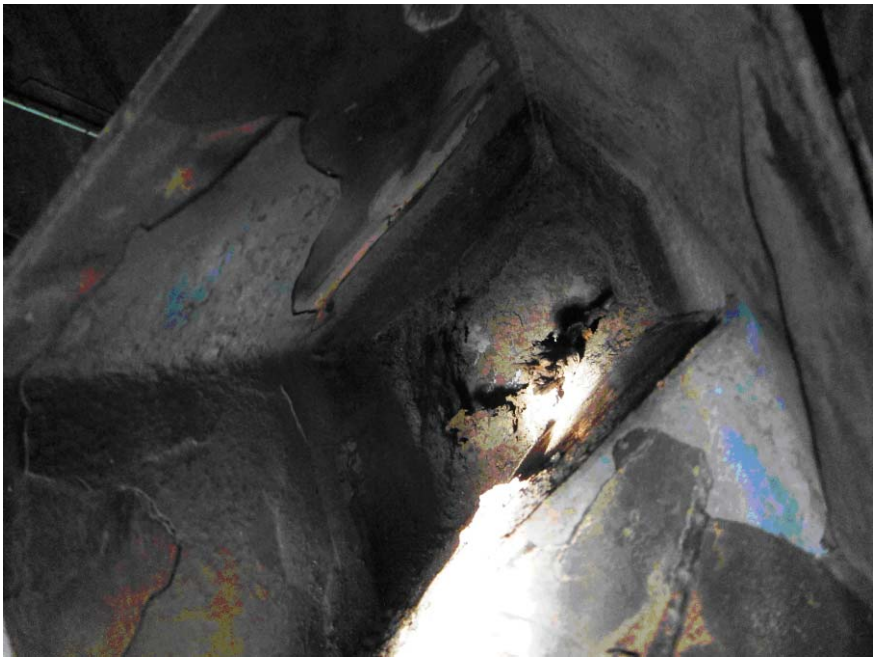
The Hartford loops are designed to be at least 3 feet above the maximum liquid level within the digester. This was confirmed both visually (see picture above) and measured.

Each mixer was supported on one single base plate secured by at least four (4) anchor bolts. All twelve (12) mixers were properly anchored.

Although the surface of the mixer appears (see picture above) to have some rust, the discoloration due to oxidation was superficial and did not appear to pose any physical or structural issue.

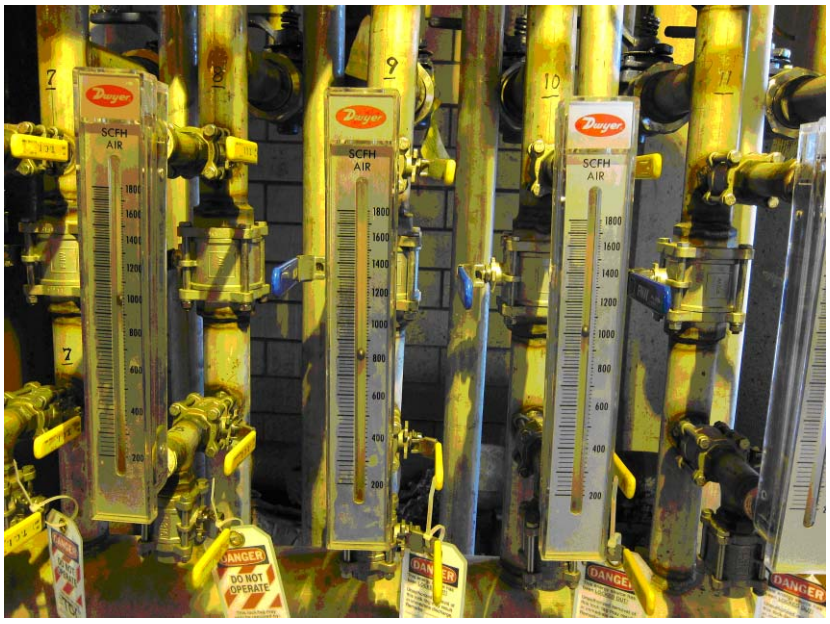
The most significant surface rust was noticed in mixer #8 throttle plate (see picture above), however on measuring the opening it was determined that the throttle plate is still within specification to operate properly without the need to be replaced.

Mixer #10 bubble generator bolt hole was bent, but does not pose any physical or structural issues. No changes required.



Mixer #12 bubble generator insides were not fully cleaned, rags were visible (see picture above) within the right section of the bubble generator that must be cleaned prior to placing the digester into service.

GENERAL RECOMMENDATIONS (NOT RELATING TO DIGESTER #2 INSPECTION)



The gas balancing system for digester #1 (which is in operation) was checked to ensure all mixers were receiving the required gas flow. Gas flow meter for mixer #9 was the only flow meter that consistently showed less flow (by 100 scfm) as opposed to the rest of the mixers. Even when we tried to balance the gas flow by throttling the gas flow to the other mixers, the #9 flow meter would continue to read less than the other flow meters; however by measuring the pressure, the gas flow to the mixer #9 appears to be operational.

We continued to troubleshoot this by by-passing a significant amount of gas through mixer #9 to eliminate the possibility of a clogged line, but had no significant impact of the measurement. We suspect the flow meter is defective, while the flow meter does not pose any operation issue, at some point in time this meter needs to be replaced with a new (or existing unused) meter to verify the gas line to mixer #9 is not clogged.

IDI also recommends that each of the digester gas balancing system be used at least once a month to check the flow to each of the mixers and adjusted or cleaned as required. Initial cleaning shall be done using just biogas pressure by throttling gas to other mixers within the same digester. Secondary cleaning shall utilize water from the roof directed directly to the bubble generator via the rodding line. Tertiary cleaning shall be done only in the even the mixer is significantly clogged (no noticeable blip in the pressure gauge on the mixer gas feed line) using flushing valve located above the throttling valve in the gas balancing system.

The biogas lines/connection in the compressor room were made of mild (or carbon steel), while the current piping configuration and material does not impact the digestion process, for the sake of longevity of digester operation it is recommended that the piping at some point in time be changed to stainless steel (304 or 316).

The addition of the Hartford loop while not significantly increasing the compress headloss during normal operation, it might be significantly undersized in the event when the biogas lines are filled with clean water used to remove obstruction during maintenance or service. Since the compressors are almost 20 years old, it is recommended that at some point in time these be replaced with newer, more efficient and economical compressor.

The heat exchangers (no picture available) appeared aged and might have run its intended working life. Newer developments in heat exchanger technology could allow replacing the existing one with smaller, more efficient exchangers. The exact design of the existing heat exchanger was not closely examined to determine an alternative.

Overall the facility was well maintained and operated very effectively. The repairs and modifications performed on the Cannon Mixers are satisfactory and pose no operation issues. No further service for digester #2 is required at this time.

SERVICE REMAINING: None on digester #2.

START- UP & TRAINING PERFORMED (Indicate yes / no): NA

SERVICE OBLIGATION COMPLETE (Indicate yes / no): Yes, no additional inspection recommended for digester #2.

IDI NAMEPLATES INSTALLED (Indicate yes / no): NA

TOTAL DAYS/HRS SERVICE THIS TRIP:	CONTRACT:	WARRANTY:	PER DIEM:	TRAVEL:

SIGNED/ FIELD SERVICE REPRESENTATIVE: Sudhakar Viswanathan

Sudhakar Viswanathan

DATE: 06/14/2012

Appendix C

Interim Inspection Report, Digester 3

MEMORANDUM

INTERIM INSPECTION REPORT
November 5, 2012; Revised January 22, 2013; Revised February 4, 2013
DIGESTER NO. 3
METRO SYRACUSE WWTP DIGESTER CLEANING AND MISCELLANEOUS REPAIRS
ONONDAGA COUNTY, NEW YORK

OBJECTIVE

The objective of this report is to summarize the Digester No. 3 observation findings, provide recommendations for repairs that could be completed while the digester is out of service, and develop recommendations for proposed Phase 2 digester improvements.

BACKGROUND

Digester No. 3 is one of four anaerobic digesters at the Syracuse Metropolitan WWTP. The digester is 100 feet in diameter with 27.5-foot high walls and a liquid capacity of approximately 1.8 million gallons. Digester No. 3 is a primary digester of concrete construction with a steel dome covered with an insulated roofing system (composed of insulation covered with a hard shell material). Originally, the digester had a concrete dome; however, the original concrete walls and dome were replaced with new concrete walls and a steel dome in the early 1970s.

The exterior walls are covered with vertical metal siding between the 12 exposed 4-foot wide concrete pilasters that are evenly spaced around the circumference of the tank. The digester has been in service for over 50 years. It is our understanding that the roofing material is about 10 years old.

OBSERVATIONS

The interior and exterior observation of Digester No. 3 was completed on November 5, 2012. The concrete structure, roofing system, piping and supports, and mixing equipment were observed. The condition assessment and associated repair recommendations are described in the following paragraphs.

STRUCTURAL

Interior

The interior surfaces of the concrete floor and wall had been cleaned off and pressure washed. Scaffolding located along the outside wall provided access to a portion of the ceiling for structural assessment.

The interior surface of the perimeter concrete wall appeared to be in good condition. The concrete walls appeared to be structurally sound with no apparent material loss or damage, similar to that found in the other digesters. There appears to be a coal tar epoxy coating along the bottom half of the wall. The top portion of the coating (starting approximately 6 feet up from the base of wall) appeared to have bonding failure, with portions bubbled up, and isolated areas where the coating is missing. There are also vertical construction joints spaced around the perimeter of the tank walls. These construction joints are filled with sealant that appeared to be aged and starting to deteriorate, but did not indicate any leaking.

Along the base of the wall, groundwater was infiltrating through the wall and floor (base slab) interface. Based on the record drawings, there is no waterstop along this interface. The drawings only indicate a sealant to be placed along the seam of the interface and then coated over with coal tar epoxy. A second layer of epoxy material appears to have been applied over this interface, which is now starting to separate from the base slab and is cracked at various locations.


Wall coating deterioration


Leaking under perimeter wall

We recommend the full length of this wall/base slab interface be pressure injected with a polyurethane type of material such as SikaFix HH+ or equal. Ports should be drilled every 6 inches in control joint to a depth of 2 or more inches deep into the joints until water seepage stops. This material should stop the leaks immediately and provide a flexible joint that should not crack if movement of the wall or base slab occurs.

Also, the failing epoxy coating (approximately 80 SF) on wall-to-slab interface should be removed and patched with a polymer-modified cementitious repair material (Sikagard 62 or equal). This repair requires a specialty contractor; acquiring one will extend the repair time. Because of the extended time, we recommend completing these repairs (pressure injection and repair of the failing epoxy) during Phase 2.

We recommend completely recoating the interior digester walls with high build epoxy coating (such as Sikagard 62). The estimated time to complete this recoat is two months. We also recommend the vertical construction joints be cleaned out and new backer rod and polyurethane sealant installed at the same time as the wall coating is replaced. Due to the cost and time required to complete this work, we recommend this recoating and joint sealant replacement be completed as a Phase 2 improvement.

The flat, center portion of the base slab was covered with groundwater that had leaked in from the base of the wall. Thus, only the perimeter portion of the base slab that slopes down to the center was dry enough for visual condition assessment. The interior surface of the perimeter portion of the concrete floor (base slab) appeared to be in good, sound condition. Unlike Digester Nos. 1 and 2 where the floor finish was smoother with only isolated areas of spalling which could be easily repaired, the surface finish of Digester No. 3 is quite rough with some minor spalling up to 1/2-inch deep. These spalls appear to be a result of poorly finished concrete during original construction and are of no structural significance. Since the concrete is structurally sound, we do not recommend smoothing out the rough surface and patching these small spall areas.

The bases of the cannon mixers were also inspected due to visual observations of grout pads in poor condition. At Cannon Mixers #2, #3, #6, and #7, the grout pads appeared to have inadequate structural integrity. It was noticed that the baseplates sounded hollow when tapped with a hammer. All other baseplates were investigated and appeared to sound hollow as well. We recommend that all grout pads be repaired immediately through a contract modification. The void spaces under all grout pads should be filled with new grout (Sikagrout 212 or 300) and the poor quality grout on Mixers #2, #3, #6, and #7

should be removed down to sound material and repacked with new grout (Sikagrout 212 or 300, or equal).


Deteriorated grout pad

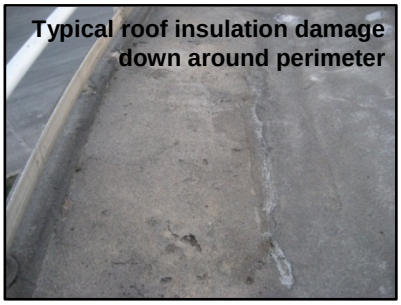
The domed roof is composed of steel plates attached to steel beams arranged in a radial pattern spanning from the perimeter tank wall to the center ring of the domed roof. In general, the steel framing and plates appear to be in good condition. The suspected coal tar epoxy coating on these members appears to be in poor condition, leaving the paint or primer finish on the steel members exposed. This has resulted in minor surface corrosion at various locations. There are a few isolated areas along the bottom stiffener rim plate of the roof skirt where there is full penetration corrosion. Based on the record drawings, we do not believe the corrosion on the bottom rim plate is a structural concern. We recommend having the steel domed roof sandblasted and recoated with an epoxy coating as a Phase 2 improvement. Prior to recoating, we recommend repairing the badly corroded areas by welding in pieces of new steel plates.


Surface of steel domed roof


Corroded roof stiffener

Exterior

The insulated roof appeared to be in fair condition, with some minor areas where the roof shell is deteriorated or cracked open. It is estimated that less than 5 percent of the roof area has this type of damage. Generally, the deteriorated roof shell was located along the perimeter and the cracked roof shell is located at the top center. We recommend a patch coat be provided to recover the exposed installation and keep moisture out in the areas where the shell is cracked. We recommend repairing these cracks immediately to prevent additional damage.


Typical roof insulation damage down around perimeter


Roof insulation damage at top center

The guardrails along the perimeter of the roof appeared to be in good condition. However, the top of the wall is cracked at locations where all the guardrail posts are embedded. At six locations, these cracks have developed into a spall area where the concrete has broken away from the face of the concrete wall. The posts are therefore not fully supported by the concrete wall in this condition. As an immediate repair, we recommend temporarily removing the guardrail posts at the six locations and patching the pockets and spalled areas with a polymer-modified patch mortar. To prevent re-spalling in the future, we recommend reinstalling the guardrail posts using surface mounts with new aluminum top-mount brackets anchored onto the top of the concrete wall.


Concrete spall at guardrail post embedment

All the remaining post embedments appear to be in fair condition. However, we recommend replacing the embedded guardrail posts with surface-mounted posts in Phase 2 to prevent damage caused by the embedded posts.

The steel access stairs and platforms on top of the roof are in good condition. However, the paint on the steel components appears to be past its useful life with signs of corrosion starting to leach through. We recommend having these stairs sandblasted and recoated with an epoxy paint as a Phase 2 repair.


Typical corrosion on access stairs and platform

There are two exposed wide concrete pilasters that appear to have a stucco finish. The manways into the tank are cast into these pilasters. The surfaces of the pilasters are dark stained, and some areas are showing horizontal cracking and spalling on the pilaster face. The stucco-type coating needs to be repaired in several different areas. We recommend repairing the cracked and spalled concrete pilasters as prescribed in our "Digester No. 1 Exterior Tank Repair Recommendations" memorandum dated September 26, 2012. This repair can be completed at any time and thus is recommended as a Phase 2 repair.


Surface damage on pilaster


Surface damage on pilaster

The metal siding appears to be in fair condition with some fading of the color and damage along the bottom edge. The damage along the bottom edge is assumed to have been caused by lawnmowing or some other equipment. (This damage has been typical for all these digester tanks.)

Only a small portion of the exterior surface of concrete wall above grade could be observed because of the metal siding. The observed concrete is in sound condition, but there appears to be suspected alkali-silica reaction (ASR) damage, which is caused when alkali in the cement reacts with silica in the

aggregates, creating a gel formation which causes cracking in the concrete surface. It is difficult and costly to remedy this issue. As long as the concrete surface is not starting to spall off, there is no need to repair the concrete surface. Based on our observations, we do not recommend any repairs of the concrete surface at this time. (Note that the other three digester tanks do not appear to have this surface damage.)

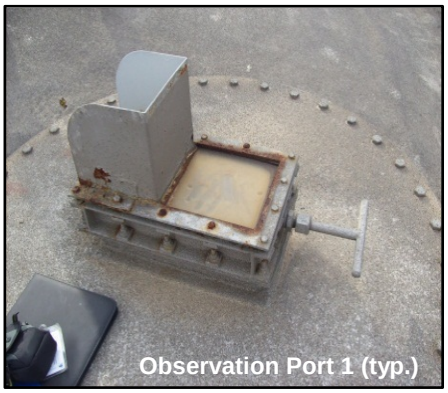

Suspected ASR damage of concrete surface

The observation ports were observed and they appear to be in fair condition. The ports are equipped with wipers. No evidence of leaking was found. It is recommended to perform a soap bubble test in the future while the digester is in service to determine whether the ports are gas tight. No recommendations are made for repairs to the observation ports at this time. In Phase 2, the interior of the ports should be sandblasted and recoated at the same time the roof is rehabilitated.

The 2-inch flushing line penetrations were observed. The County staff and the contractor aided in the inspection of these penetrations. On the exterior of the roof, some corrosion of the steel sleeve was observed, but most of the corrosion was from the mixer I.D. tag chain. The County staff and the contractor removed the foam insulation filling the space between the sleeve and pipe at one of the penetrations in order to observe the link seal. When removing the insulation, it was found that there was approximately a 1- to 2-inch water column sitting on top of the link seal, indicating the link seal was not leaking. The County staff removed the water using compressed air. The top of the link seal was observed and appeared to be in fair condition. On the interior, it was difficult to observe the link seal. There was also corrosion around the pipe penetration area.

Since the link seals do not appear to be leaking, it is not recommended to replace them at this time. However, it is recommended that the link seals be replaced during Phase 2, along with sandblasting and recoating the sleeves, at the same time the roof is rehabilitated. As an immediate repair, it is recommended that the pipe penetrations on the exterior be sealed to prevent further water damage. The deteriorated foam insulation should be removed and new spray foam insulation added to fill the void space. One solution to preventing water from entering the gap between the pipe and sleeve is to install a Fernco-type coupling over the area.

Link seal

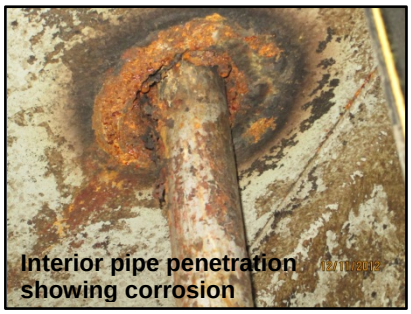

Observation Port 1 (typ.)

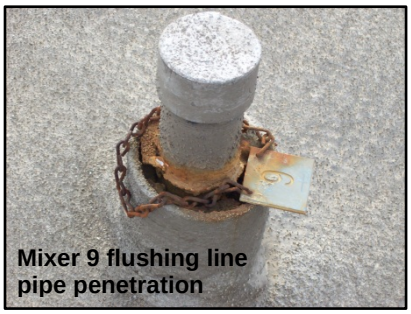

Observation Port 2 (typ.)


Observation port showing corrosion


Pipe penetration sleeve, inside


Interior pipe penetration


Interior pipe penetration showing corrosion


Mixer 9 flushing line pipe penetration

MECHANICAL

Sludge Withdrawal Pipes

There are two 6-inch diameter ductile iron sludge withdrawal pipes in Digester No. 3. They terminate at the center of the digester and are routed along the bottom slope of the floor. The pipes are supported by concrete block. Both pipes and all supports appear to be in fair condition. No recommendations are made at this time for corrective repairs to the sludge withdrawal pipes or supports.

Sludge Feed Pipes

There are two 8-inch diameter ductile iron sludge feed pipes in Digester No. 3 which terminate at the center of the digester. There is a low feed and a high feed. The low feed is just off the floor and the high feed is about 3 feet above. The pipes are supported by concrete block with wood framing. Both sludge feed pipes appeared to be in poor condition, with scale build-up inside the pipe; however, the contractor was able to clean much of the scale out when flushing the lines. This will keep the pipes functional at least until the next digester cleaning. It is recommended that these pipes be replaced in Phase 2, all the way back to the Digester Control House.

The concrete supports appeared to be in fair condition. No recommendations are made at this time for corrective repairs.


Supernatant recirculation elbow

Sludge Recirculation Suction Elbow

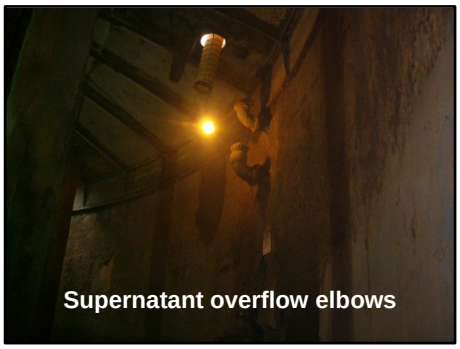
Each primary digester is equipped with a single 8-inch diameter sludge recirculation suction (ductile iron) elbow. The recirculation suction pipe enters the digester and elbows up. The intake of the elbow is approximately 10 feet above the bottom of the digester wall. The recirculation elbow appeared to be in fair condition. No recommendations are made at this time for corrective repairs.

Sludge Low Supernatant Overflow Elbow

Each primary digester is equipped with a single 8-inch diameter sludge low supernatant overflow (ductile iron) elbow. The low supernatant overflow pipe enters the digester and elbows up. The intake of the elbow is approximately 22 feet above the bottom of the digester wall. The low supernatant overflow elbow appeared to be in fair condition. No recommendations are made at this time for corrective repairs.

Sludge High Supernatant Overflow Elbow

Each primary digester is equipped with a single 8-inch diameter sludge high supernatant overflow ductile iron elbow. The high supernatant overflow pipe enters the digester and elbows up. The intake of the elbow is approximately 26 feet above the bottom of the digester wall. The high supernatant overflow elbow appeared to be in fair condition. No recommendations are made at this time for corrective repairs.


Supernatant overflow elbows

Digester Gas Feed Pipes

There are 12, 2-inch diameter stainless steel digester gas feed pipes in each primary digester which supply digester gas to 12 mixing guns. Three mixing guns are located in an inner ring and nine mixing guns are located in an outer ring. The 2-inch stainless steel gas pipes discharge at each mixing gun into a “bubble generator” box. The pipes are supported by carbon steel pipe supports.

The 2-inch gas feed piping and supports to Cannon Mixers #6, #9, and #10 have failed and are bent over. At a minimum, approximately 120 linear feet of pipe and associated supports should be replaced immediately while the digester is out of service.

All of the gas feed piping supports show corrosion. It appeared to be worse at the bottom, where some of the supports have completely eroded away. It is recommended that all pipe supports be replaced with stainless steel supports and hardware while the digester is out of service. We recommend pipe supports be replaced in kind with Schedule 40, 304 stainless steel, and all replacement hardware and plates with 316 stainless steel. In the current contract, Payment Item 7 should be used to replace 2-inch stainless steel gas feed piping and supports while the digester is out of service. Subsequent to initial submission of this memorandum, the County negotiated a modification for completion of this work.

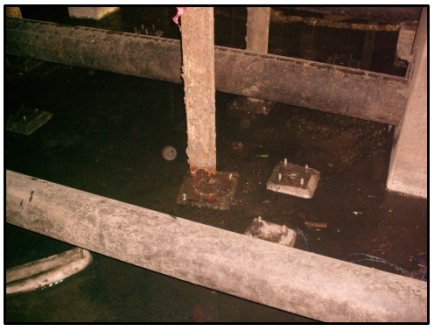
The nipple for the union connection of the 2-inch gas feed piping that is welded to the bubble generator on Mixer #9 is corroded through. All other unions are considered suspect; therefore, we recommend replacing all 12 nipples with new coated carbon steel nipples while the digester is out of service.


Bent 2-inch pipes and supports


Bent 2-inch pipes and supports


Corroded nipple at Mixer #9

The photos which follow show the corrosion on the pipe supports.







Digester Gas Mixing Guns

This mixing guns appear to be in fair condition; however, some of the coating has worn off of the mixing gun tube. In order to increase the life expectancy of the mixing guns, we recommend recoating them. The cost of recoating the mixing guns for Digester No. 3 would be approximately $120,000. Due to the

time and cost required to recoat the mixing guns, it is recommended that this work be completed during Phase 2. Coating has also worn off the carbon steel bubble generators, resulting in some corrosion around the throttle plate openings on some of the mixers. In Phase 2, it is recommended to either recoat the bubble generators or replace with stainless steel.

Cannon Mixers #1, #8, #9, and #11 were missing the throttle plates at the bottom of the bubble generator. We recommend adding new throttle plates while the digester is out of service. On Mixers #9 and #11, a new custom throttle plate should be made to fit over the existing hole because the corrosion has led to an increase in the opening size. All of the existing throttle plates were installed improperly. They should be rotated 180° so the size of the opening is approximately 4 inches by 2 inches.


Corroded throttle plate opening - Mixer #6


Corroded throttle plate opening - Mixer #11


Corroded throttle plate opening - Mixer #9


Corroded draft tube on Mixer #10

Some of the steel around the area of the throttle plate openings showed corrosion on Mixers #6, #9, and #11. The corroded areas should be surface prepared for recoating and recoated.

Mixer #10 showed corrosion around the bottom perimeter of the draft tube. This corrosion should be surface prepared for recoating and recoated while the digester is out of service.

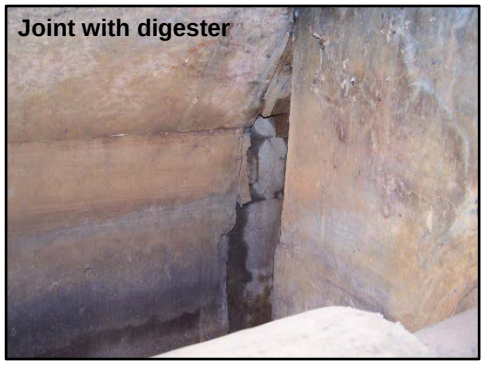
Replacing throttle plates is covered under Payment Item 13, Steel Repair. Repairing the corroded areas is covered under Payment Item 11, Miscellaneous Painting/Coating.

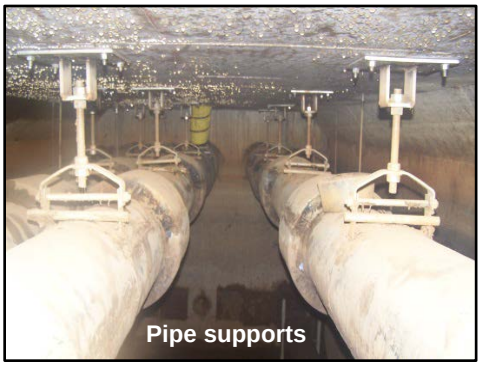
Digester No. 3 Pipe Chase

The pipe chase between the Digester Control House and Digester No. 3 was visually observed. The joints between the pipe chase and the Digester/Digester Control House walls did not show as much evidence of leaking as the other pipe chases. The condition of the pipes could not be determined due to the insulation wrapped around all of the pipes. The insulation appeared to be in fair condition. No recommendations are made at this time for repairs to the pipe insulation.

There appeared to be sludge covering the bottom of the pipe chase and the lower pipes. It is recommended that all the sludge sediment in the chase be washed off the pipes and pumped out. This can be done at any time and thus is a Phase 2 recommendation.

The pipe supports appeared to be in fair condition. No recommendations are made at this time for corrective repairs to the Digester No. 3 pipe chase supports. The following are photos of the pipe chase.


Joint with digester


Pipe supports


Digester Control House wall


Pipes wrapped with submersible insulation

Repair Recommendations

Short-term repair recommendations are as follows:

1. Repair grout pad at each mixing gun. This work will require a modification.

2. Repair/patch cracked insulation on roof with a urethane coating (Sikalastic 621 or equal). This work will require a modification.

3. Remove the guardrail posts at the six locations where the concrete cap is cracked. Patch the pockets and spalled areas with a polymer-modified patch mortar. Reinstall the guardrail posts with surface mounts with new aluminum top-mount brackets anchored into the concrete cap. This work will require a modification.

4. Replace a minimum of 120 linear feet of 2-inch stainless steel gas feed pipe and associated supports. Replace all other gas feed pipe supports. This work is covered under Unit Price Payment Item 7 (completed as a negotiated modification).

5. Replace 12 nipples at gas feed to bubble generator (one per mixer). This will require a modification.

6. Replace the missing throttle plates on Cannon Mixers #1, #8, #9, and #11. On Mixers #9 and #11, the corrosion has increased the size of the existing opening. Therefore, it will be necessary to replace with larger throttle plates. This work is covered under Unit Price Payment Item 13.

7. Rotate all throttle plates so that the opening is approximately 4 inches by 2 inches. This work will require a modification.

8. Repair corrosion on areas around throttle plates for Cannon Mixers #6, #9, and #11. This work is covered under Unit Price Payment Item 11.

9. Repair corrosion on bottom perimeter of Cannon Mixer #10 draft tube. This work is covered under Unit Price Payment Item 11.

10. Seal gap between flushing pipe and steel sleeve to prevent further water damage.

Long-term recommendations (Phase 2) for Digester No. 3 include the following:

1. Pressure injection grouting of slab/wall interface.

2. Remove failing epoxy coating of wall/slab interface and patch with a polymer modified cementitious repair material.

3. Recoat interior steel dome roof and walls, including steel penetrations through the roof. Replace corroded steel plates with new steel plates. Replace flushing line penetration link seals.

4. Clean out vertical construction joints and install new backer rod and polyurethane sealant.

5. Replace the insulation on the roof exterior.

6. Reinstall all remaining embedded guardrail posts using surface mounts with new aluminum top-mount brackets anchored into the parapet extensions.

7. Sandblast and recoat stairs/platform leading to digester.

8. Repair cracked/spalled concrete of exterior pilasters.

9. Recoat mixing guns.

10. Recoat or replace carbon steel bubble generators with stainless steel.

11. Clean sludge out of pipe chase.

12. Replace sludge feed pipes back to Digester Control House.

All repairs should be made in accordance with the contract specifications and the manufacturer's specifications. Table 1 shows either actual or estimated costs of the short-term repairs recommended for Digester No. 3. Table 2 is a cost estimate of the long-term recommendations.

TABLE 1

PHASE 1
REPAIR RECOMMENDATIONS COST ESTIMATE

Repair	Quantity	Unit	Payment Item No.	Material Unit Price[1]	Labor	Total Cost
Repair grout pad at each mixing gun	Completed by Owner					
Recoat cracked insulation on roof	Owner will complete					
Remove/repair spalled concrete and reinstall guardrail posts at six locations using surface mounts	Owner will complete					
Replace 2-inch gas piping and supports	120	LS	Modification	N/A	Included	$60,000
Replace corroded nipples	12	LS	Modification	N/A	Included	$2,400
Replace missing throttle plates – Mixers #1, #8, #9, #11	Owner will complete					
Rotate throttle plates 180°	Owner will complete					
Repair corroded throttle plate openings - Mixers #6, #9, #11[2]	1	SF	11	$15	Included	$15
Repair corroded area at bottom of Mixer #10 draft tube[2]	1	SF	11	$15	Included	$15
Seal flushing line roof penetration	Owner will complete					
TOTAL CONSTRUCTION COST						**$62,430**

(1) Unit price based on contractor's bid where appropriate.
(2) Estimated cost.

TABLE 2

PHASE 2
RECOMMENDATIONS

Repair	Quantity	Unit	Material Unit Price	Labor	Total Cost
Pressure injection grouting of slab/wall interface	315	LF	$100	Included	$31,500
Remove failing epoxy coating at wall/slab interface and patch	80	SF	$18	Included	$1,440
Recoat interior roof and walls, including steel penetrations through roof	20,000	SF	$9	Included	$180,000
Clean out vertical construction joints and install new backer rod and polyurethane sealant	280	LF	$10	Included	$2,700
Replace insulation on roof and recoat	1	LS	N/A	Included	$95,000
Reinstall remaining embedded guardrail posts using surface mounts	80	Each	$100	Included	$8,000
Sandblast and recoat roof stairs and platform	1	LS	N/A	Included	$10,000
Repair cracks/spalls in pilasters	200	SF	$40	Included	$8,000
Recoat mixing guns/bubble generators	6,000	SF	$20	Included	$120,000
Clean sludge out of pipe chase	1	LS	N/A	Included	$1,000
Replace sludge feed pipes	200	LF	$40	Included	$8,000
SUBTOTAL					**$470,000**
Construction Contingency (5%)					30,000
Contractor's Overhead and Profit (20%)					100,000
TOTAL CONSTRUCTION COST					**$600,000**

Appendix D - Interim Inspection Report, Digester 4

Digester No. 4 Addendum No. 1

Digester No. 4 Addendum No. 2

MEMORANDUM

INTERIM INSPECTION REPORT (Revised February 4, 2013)
DIGESTER NO. 4
METRO SYRACUSE WWTP DIGESTER CLEANING AND MISCELLANEOUS REPAIRS
ONONDAGA COUNTY, NEW YORK

OBJECTIVE

The objective of this report is to summarize the Digester No. 4 observation findings, and to provide recommendations for repairs that could be completed while the digester is out of service and those repairs which may be necessary for Phase II/III digester improvements.

BACKGROUND

Digester No. 4 is one of four anaerobic digesters at the Syracuse Metropolitan WWTP. The digester is 100 feet in diameter with 24.5-foot high walls and a liquid capacity of approximately 1.6 million gallons, and is used as a secondary digester. The digester is equipped with a floating cover manufactured by Dorr-Oliver which is used to store digester gas. The cover has a dome-shaped top with a vertical side wall (skirt) and consists of an assembly of steel plates (panels) over structural steel members. The cover is supported on a center column consisting of an outer column that slides vertically over an inner column. The inner column is fixed to the tank floor and stabilized by tie rods. The outer column is welded to the cover. Concrete ballast is located on the top exterior of the cover along the perimeter. When the cover is in the bottom-most position, the skirt rests on 18 concrete corbels that are evenly spaced along the inside wall about 8 feet above the floor. The concrete digester and floating steel cover are believed to have been in service for over 50 years.

The cover is stabilized by a series of tie rods. The following is a description of the various tie rods. A drawing of the digester titled “The Dorr Digester,” which shows the various types of tie rods, is attached to this memorandum. As shown on the elevation view of this drawing, the digester has three types of tie rods. The first, Type A, are inner center column stabilization tie rods. These 12 tie rods are stationary and help stabilize the center column. They are connected from the digester tank wall to the top of the inner center column. The second type, Type B, are diagonal tie rods connecting the perimeter of the cover to the bottom of the outer, movable center column. These 18 tie rods help balance the cover during movement up and down. The third type, Type C, are horizontal tie rods connecting the bottom perimeter of the digester skirt to the middle of the outer, movable center column. These six tie rods also aid in balancing the cover on the center column.

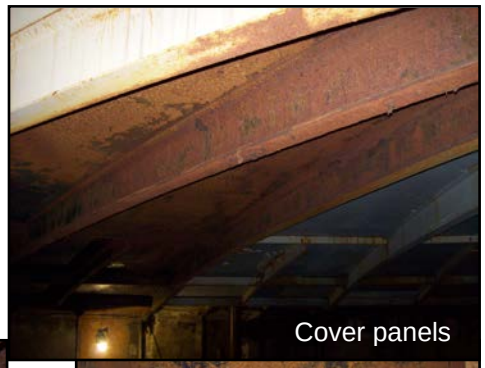
OBSERVATIONS

The interior and exterior observation of Digester No. 4 was completed using still photographs and video on October 12, 18, and 19, 2010. The concrete structure, floating steel cover, mechanical pipes, and accessories were observed.

Digester Cover

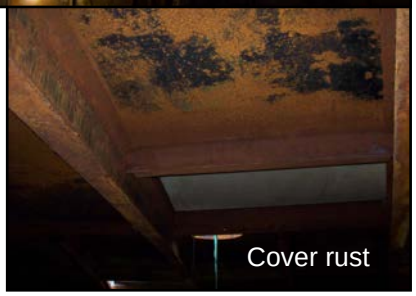
The carbon steel cover panels and structural members appear to be in good structural condition. The condition of the surface varies. On the interior of the dome (roof) portion of the cover, some of the panels have previously been recoated/rehabilitated, as could be seen from the difference in color between the panels. It appears that the light-colored sections have been more recently recoated, and

the black and apparently uncoated sections have not been refinished. The light-colored sections appear to have only isolated areas of surface corrosion. The black sections and uncoated sections appear to have widespread areas of surface corrosion. When evaluating the light, black, and uncoated colored members, no variation of structural member thickness could be measured. In 1999, an inspection was conducted and the paint was found to contain lead; however, the sample location drawing and sample analysis could not be located.


Cover panels


Cover rust


Cover rust


Cover rust

Due to the time constraints for surface preparation and paint application, we do not recommend recoating the entire cover at this time. We anticipate it would take a minimum of two months to perform sandblasting and coating of the entire cover. This includes disconnection and reconnection of all the tie rods, resetting scaffolding, and lead abatement measures. This would delay the return of the digester to service and its benefits in providing supplemental heating. Secondly, since we did not measure any loss of thickness between structural members, we believe the corrosion is limited to the surface. However, we recommend that this be verified by ultrasonic thickness measurements. This testing could be completed from the exterior of the digester, at any time. According to the manufacturer, the panels are typically 1/4-inch thick, with 1/8-inch thickness for structural integrity and 1/8-inch thickness for corrosion allowance.

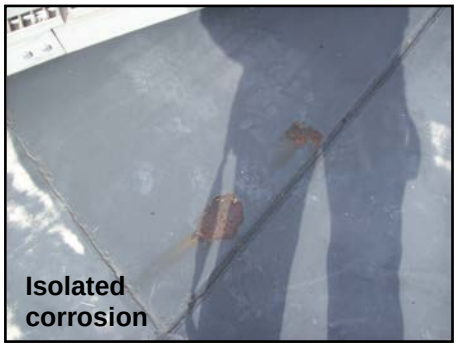
In the future, if the cover is to be rehabilitated, we recommend removing the entire cover from the digester to aid in a full rehabilitation of the cover and tank, including: (1) sandblasting and recoating the cover; (2) sandblasting and recoating the center column; and (3) sandblasting and recoating concrete walls. However, before rehabilitation is done, ultrasonic thickness testing should be completed again to determine if there is any loss of thickness. Also, the cost of cover replacement should be compared with the cost of rehabilitation. This evaluation will be done as part of the Technical Report in Task 6.

Digester Skirt

The inside of the digester skirt (vertical section of cover) appears to be in good condition with only minor surface corrosion. One section of the vertical skirt was damaged such that a parabola-shaped crease was formed. This deformation was not identified in the 1999 inspection report. This crease does not appear to pose a structural or functional problem, and we make no recommendations to repair the crease. Some of the vertical stiffeners are slightly bent where the diagonal tie-rods are connected. These bent stiffeners do not appear to impair the structural integrity of the cover. We make no recommendation to correct them at this time.

Cover/Skirt Exterior

On the exterior top (roof) section of the cover, the coating is in fair condition with some isolated areas of corrosion present. The exterior surface of the skirt could not be observed since it is not accessible with the cover in place. However, the top portion of the exterior skirt was visible and appeared to be in good condition in our November 18, 2009 inspection. As can be seen in the "Digester No 4 exterior" photo below (taken in November 2009), we observed that the cover was tilted. This was confirmed by County employees.



Center Column

The center column assembly appears to be in good condition. The inner column appears to have been coated with a coal tar epoxy which is failing in several sections along the length. We do not recommend recoating the inner column at this time due to the inaccessibility of the entire column.

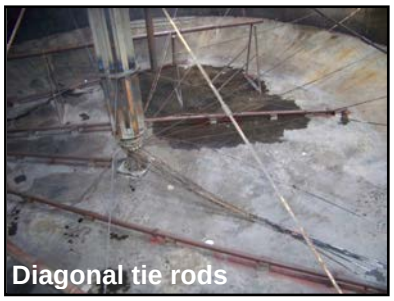
Cover Tie Rods

The following is a summary of the cover tie rod observations:

- The 12 tie rods that stabilize the inner center column assembly (Type A) appear to be in good condition. One of the tie rod anchor plates on the concrete is cracked as shown in the photo on page 5 labeled "Cracked anchor plate." This was noted in the 1999 inspection report.

  The condition of the plate is consistent to what was described in the 1999 inspection report and does not appear to be have deteriorated further. Three of the four anchor bolts are unaffected by the crack, which is limited to the top right corner of the plate. However, while the digester is out of service, we recommend either repairing by welding or replacing this plate in kind.

- Eighteen diagonal tie rods connect the top perimeter of the cover to the base of the exterior moveable column. Each diagonal tie rod (Type B) consists of five segments connected to each other with threaded turnbuckles. Each rod is connected to a hub at the base of the outer (moveable) center column with a hemispherical nut. Over time, many of the tie rods apparently unscrewed from the turnbuckles and have fallen to the floor of the digester. Many of the fallen tie rods are bent. No issues with these rods were identified in the 1999 inspection report.


Diagonal tie rods

  These diagonal tie rods are necessary for the structural integrity and balance of the cover over its range of travel. Therefore, it is recommended to replace as necessary and reinstall the tie rods before the digester is placed back in operation.

- The six horizontal tie rods (Type C) appear to be in good condition and were intact with the exception that some of them were slacked. These tie rods are also composed of sections joined with threaded turnbuckles. We recommend all of these rods be retensioned.

  These rods are pinned to connecting plates that are welded to the moveable center column. Two of the connecting plates at the center column assembly had large deformation (wear) of the mounting holes that appeared to have been caused by movement of the tie rods over time.


Horizontal tie rod anchor

Cover Guide Angles

Four guides are installed on the digester walls to prevent rotation of the cover. The guides are constructed of vertical steel angles bolted to the concrete wall. Each angle engages a fin welded to the exterior of the cover skirt. Three out of the four digester cover guide angles appear to be in good condition. However, there is one guide angle that appears to have been modified. This modification may have been added to alleviate binding of the cover. No recommendations are made for this cover guide angle. It should be evaluated again after operation of the cover.


Indentation at cover fin attachment


Cover guide angle

On the inside of the cover skirt, there are indentations where the fin attachment is welded to the skirt. Some of these indentations are corroded and if allowed to corrode further, could create a through-hole and result in a point for leakage of gas. In order to protect this area from corrosion, we recommend welding a steel plate on the inside of the digester skirt over the area of the indentations. This repair should be completed prior to placing the digester back on line. Since the paint is lead based, surface preparation must be completed in accordance with SSPC-6, Guide for Containing Debris Generated during Paint Removal Operations, and SSPC-7, Guide for the Disposal of Lead-Contaminated Surface Preparation Debris.

Interior Concrete

The interior surface of the concrete wall and floor appears to be in good condition. The concrete wall appears to be structurally sound with no observed concrete loss or damage. The wall appears to have been coated. Some of the coating has deteriorated. A portion of the wall could not be inspected because it was covered by the cover skirt. The concrete floor appears to be structurally sound, but has some isolated areas of spalls/concrete breakout. These floor spalls do not appear to have structural significance. No evidence was observed to indicate there was a coating on the floor surface. We do not recommend recoating the tank walls at this time due to the inaccessibility of the large area of wall covered by the cover skirt. We do recommend recoating the tank wall in the future when the cover is completely removed for rehabilitation or replacement and the entire tank wall is exposed.

The concrete corbels, in general, appear to be in good structural condition, although some spalling was observed. Many show slight spalling, while others showed more significant spalling. All of these spalled areas can be repaired at this time through Payment Item 5 of the construction contract.


Cracked anchor plate


Spalled corbels


Spalled corbels


Spalled corbels


6-inch gas pipe wrap

Mechanical

The pipes, fittings, and pipe supports in the digester appear to be in good condition. We observed the pipe penetrations and found no apparent signs of leakage. The pipe penetrations appear to be sealed with a lead caulking. The 6-inch digester gas transition pipe through the digester wall is wrapped with what appears to be a butyl rubber-type wrap. Some of this wrap has come undone and is loosely hanging. Also, one of the pipe supports is missing a bolt. The wrap should be repaired and bolt replaced before the digester is placed back into service.

The piping and valves on top of the digester cover appear to be fairly new and in good condition. No recommendations are made for the piping and valves on top of the cover.

Pipe Chase

The pipe chase between Digester No. 4 and the Digester Control House was inspected on November 16, 2010. It is below grade and houses all of the below-grade piping between the two structures. The pipe chase is approximately 10 feet wide by 10 feet tall by 30 feet long. Under normal conditions, the bottom half of the chase is below groundwater level. Therefore, the chase had to be pumped out for the inspection. The groundwater appears to be entering at gaps in the connection of the chase to the Digester Control House. It is recommended these gaps be sealed to reduce the groundwater surcharge in the pipe chase. These gaps can be sealed at any time and are therefore considered Phase 2 Improvements.


Pipe chase entrance


Groundwater seepage point

The pipes in the pipe chase are ductile iron and appear to be in good condition. Most of the pipes and couplings located below the normal groundwater level have been coated with a coal tar epoxy which has protected the piping from corrosion. Replacement of pipe is not necessary or recommended.


Coal tar epoxy on lower piping

The pipe penetrations and link seals appear to be in good condition. Replacement of link seals is not necessary or recommended. However, the wall sleeve for the penetration of the 14-inch gas line is corroded. This corrosion should be sandblasted and recoated with coal tar epoxy. This work can be done at any time and is recommended to be completed as a Phase 2 improvement.


Digester Control House penetrations


6-inch capped penetration


14-inch wall sleeve with corrosion

The pipe supports were observed and they appeared to be in good condition. No recommendations are made for the replacement of any pipe supports.


Pipe supports

The couplings were also observed. Seven 8-inch couplings show corrosion. All of the corroded couplings are on pipes that did not have coal tar epoxy protection and experience occasional submergence. It is recommended that these seven couplings be replaced while the digester is out of service. Prior to installation, the couplings shall be coated with two coats of coal tar epoxy.


Corroded couplings on 8-inch sludge feed pipes


Corroded coupling on 8-inch recirculation suction

The coal tar epoxy coating is flaking off the pipes. It is recommended that the existing piping and couplings in the pipe chase which have a coal tar epoxy coating be sandblasted and recoated with coal tar epoxy for protection. In addition to this, all of the existing piping and couplings which are not coated should be coated with coal tar epoxy. This work can be done at any time and is considered a Phase 2 improvement.

REPAIR RECOMMENDATIONS

Short-term repair recommendations for completion during the time the digester is out of service are:

1. Reinstall all disconnected (Type B) diagonal tie rods connected to the cover. Replace all bent or unusable tie rods, turnbuckles, hex nuts, and washers. Install locking hex nuts on both ends of every turnbuckle on all diagonal tie rods. The diagonal tie rods are 7/8-inch diameter rods. Replacement tie rods will be constructed of 316 stainless steel. This work would require a Modification Order.

   Retension (Types B and C) tie rods to a minimum specified torque of approximately 50 ft-lbs. Tension for all Type B and all Type C tie rods shall be consistent.

2. Repair the cracked anchor plate for the inner column stabilization tie rod. Refer to attached Figure 1 for location. This plate is constructed of cast iron and can be repaired by welding or replaced in kind. The plate manufacturer was unable to find the casting for this plate, so the plate would have to be fabricated. This might be a costly option and welding appears to be the more cost-effective choice. This work would require a Modification Order.

3. Balance the cover. A qualified factory representative should support this work with a site visit if necessary. Balancing typically involves calculating loading on the exterior of the cover, then filling the digester with water until a seal is created. Compressed air is then added to the tank to initiate the movement of the cover. After the floating cover rises on the air, the cover is balanced, adjusting the cover and ballast weight as necessary to achieve a gas pressure of 10 inches of water column. The manufacturer estimates that this may take approximately one day. A Modification Order would need to be prepared for this work.

4. Leak test seams of cover by soaping the seams. A Modification Order would have to be prepared for this work.

5. Repair concrete corbels with spalling according to manufacturer's written recommendations. Figure 1 attached shows the locations of the corbels in need of repair. It is estimated that 10 square feet of spalling concrete needs repair. This work can be completed under Payment Item 5.

6. Replace two deteriorated tie rod connection plates on center column. Attached Figure 1 shows the location of these two plates. The contractor will cut off the existing plate and replace in kind. This work can be completed under Payment Item 13.

7. Replace corroded Dresser couplings on 8-inch piping in pipe chase between Control House and digester. There are seven couplings recommended for replacement. Attached to this memorandum is a drawing dated June 1, 1971 titled "Existing Gas Holder." Section 2 of this drawing shows the pipes in the chase. This drawing should be used for reference in locating the couplings to be replaced. The seven couplings recommended for replacement are listed as follows: (a) the couplings on both 8-inch sludge feed lines closest to the digester (total quantity = 4); and (b) the last three couplings on the recirculation suction line closest to the Digester Control House (total quantity = 3). These couplings shall be replaced with ductile iron fittings, Smith Blair Model 441 or equal with stainless steel bolts and nuts. The couplings shall receive two coats of coal tar epoxy paint prior to installation. A Modification Order would have to be prepared for this work.

8. Cut off loose hanging wrap on 6-inch gas transition pipe. The County will complete this work.

9. Indentations of cover fin attachment on the interior of the skirt should be repaired by welding steel plates over each indentation. The plates shall be 1/4-inch thick carbon steel. This work can be completed under Payment Item 13. The total quantity of steel repair for which payment shall be made will be the total number of pounds of steel plate added as determined by the Owner.

10. Replace missing bolt in pipe support with appropriate size stainless steel bolt. This work should be covered under Payment Item 13.

All repairs shall be made in accordance with the contract specifications and the manufacturer's specifications. The repairs that are covered under the unit price items are listed as so in Table 1.

As a part of the Final Technical Report, GHD will evaluate the cost of the Phase 2 digester cover rehabilitation repairs versus replacement of the digester cover.

TABLE 1

REPAIR RECOMMENDATIONS COST ESTIMATE

Material	Quantity	Unit	Payment Item No.	Material Unit Price	Labor and Equipment	Construction Cost
Replace (Type B) diagonal tie rods and associated hardware[1]; retensioning Types B and C	40	Rods	Modification Order	$200	$12,000 [2]	$20,000
Repair cracked anchor plate for inner column stabilization tie rod	16	Hours	Modification Order	--	--	$800
Manufacturer visit to balance of the cover	1	Day	Modification Order	--	--	$4,750
Contractor's effort in balancing cover[3]	32	Hours	Modification Order	--	--	$1,600
Leak testing cover seams[3]	32	Hours	Modification Order	--	--	$1,600
Repair of spalled concrete corbels[4]	10	Square Feet	Payment Item 5	$18	--	$180
Replace two deteriorated tie rod connection plates on center column[4]	40	Pounds	Payment Item 13	$12	--	$480
Replace 8-inch couplings in pipe chase	7	Each	Modification Order	$500	$1,750	$5,250
Weld plates on top of indentations of cover fin attachment[4,5]	160	Pounds	Payment Item 13	$12	--	$1,920
SUBTOTAL Construction Contingency (5%) Overhead and Profit (20%) for Modification Order Items						**$36,580** $1,800 $6,800
TOTAL CONSTRUCTION COST (rounded)						**$45,000**

(1) There is a total of 90 diagonal tie rod segments. The cost estimate is based on 40 tie rods requiring replacement. The exact number will be determined when the Contractor sorts the disconnected rods.
(2) Based on 3 workers, 10 days, at $50/hour.
(3) Unit price based on contractor's bid.
(4) Based on two workers, two days, at $50/hour.
(5) Based on an estimate of 16, 12-inch x 12-inch x 0.25-inch plates added.

ADDENDUM NO. 1

INTERIM INSPECTION REPORT (January 3, 2011)
DIGESTER NO. 4
METRO SYRACUSE WWTP DIGESTER CLEANING AND MISCELLANEOUS REPAIRS
ONONDAGA COUNTY, NEW YORK

On November 19, 2010, Digester No. 4 was revisited with the purpose of accomplishing three objectives:

1. To confirm that the center column is plumb.
2. To measure the level of the top of the digester tank wall.
3. To measure the skirt gap (distance between the skirt and the tank wall) at the top of the skirt.

The center column was confirmed to be plumb within measurable tolerance. While measuring the center column plumbness, we observed that the vertical exterior I-beam of the outer center column nearest to the digester ladder appeared to be bowed near the top. The bow does not appear to pose a structural or operational problem, and no corrective actions are recommended.

The elevations of the top of the digester tank wall were measured. An assumed elevation of 100 feet was used as a benchmark at location A, as shown on attached Figure 2, Digester 4 Tank Wall Elevations and Skirt Gap Measurements. The measurements show that the top of the tank wall is slightly lower on the northern side as compared to the southern side by up to a maximum of 6 inches. This situation was discussed with the cover manufacturer, who was of the opinion that 6 inches out of level would not cause a problem with the movement of the cover. No corrective actions are recommended at this time. These elevations should be checked again in five years to determine if the tank is or is not in the process of setting.

The measurements of the gap between the skirt and the tank wall are also shown on Figure 2. There are variations in the skirt gap around the digester. These variations could be due to an out-of-round cover or tank. At the narrowest gap (labeled B-2), the ballast trough appeared to be deflected inward towards the wall, possibly due to the weight of the concrete in the trough. Since this was an existing condition, the cover should be able to operate as it has in the past. Therefore, no corrective actions are recommended at this time. However, the skirt/tank clearance should be examined during the balancing and initial operation of the floating cover.

ADDENDUM NO. 2

INTERIM INSPECTION REPORT (April 7, 2011)
DIGESTER NO. 4
METRO SYRACUSE WWTP DIGESTER CLEANING AND MISCELLANEOUS REPAIRS
ONONDAGA COUNTY, NEW YORK

The Digester No. 4 Interim Inspection Report did not address the condition of the concrete outside of Digester No. 4. This Addendum reports our findings of the condition of the exterior concrete surfaces.

The exterior surfaces of the concrete walls could not be observed because of the metal siding and roofing material. Therefore, the assessment is of the exposed concrete pilasters.

The extent of damage varies among the pilasters. Some pilasters show deterioration with vegetative growth on them. The exposed pilasters appear to have a stucco finish. Many of the surfaces are dark stained and some areas are showing horizontal cracking evenly spaced from the top to approximately halfway down the pilaster. The stucco-type coating needs to be repaired in several areas. There is a significant horizontal crack along the top of every pilaster, which may indicate more than just cracking in the stucco-type coating. The inside face and tops of the pilasters have damage due to cracking and deterioration.

We recommend repairing the cracked/spalled and deteriorated concrete pilasters and recoating all of the exposed surfaces. This repair can be completed at any time and, therefore, is classified as Phase 2 repair recommendation. The approximate square footage of cracked/spalled and deteriorated concrete requiring repair is 240 square-feet. Payment Item No. 5 could be used for this repair. The approximate square footage of coating repair is 960 square-feet. A modification would be required for the exterior coating repair. The estimated cost of concrete repair for the pilaster of Digester No. 4 is $19,000.

Although this repair can be done at any time, this contract provides a good opportunity to complete the repairs because of the payment items for the concrete repair.

Photo 1: Typical Pilaster (Interior)

Photo 2: Typical Pilaster (Exterior)

Photo 3: Pilaster Cracks and Vegetative Growth

Appendix E
Interim Inspection Report, Digester Control House

Photographs of 8-Inch Carbon Steel Pipe Recommended for Replacement

MEMORANDUM

INTERIM INSPECTION REPORT (Revised February 4, 2013)
DIGESTER CONTROL HOUSE
METRO SYRACUSE WWTP DIGESTER CLEANING AND MISCELLANEOUS REPAIRS
ONONDAGA COUNTY, NEW YORK

The Onondaga County Department of Water Environment Protection retained GHD (formerly known as Stearns & Wheler) to complete the final design and construction phase services of the METRO Syracuse WWTP digester cleaning and miscellaneous repairs project. Task 3 inspection services included a subtask of inspecting the equipment and the building structure in the Digester Control House. The scope of this inspection included a review and summary of:

- age
- model
- manufacturer
- availability of spare parts
- effectiveness of component (has technology changed)
- redundancy in the system (how critical is the component)
- physical condition
- frequency of corrective maintenance
- building structure

The scope of services did not include a review of compliance with current Design or Building Codes.

The project schedule included completion of this task in 2010. However, the County requested that this task be completed as soon as possible to determine if additional digester system repairs or component replacement should be incorporated into this project. This memorandum summarizes the Digester Control House inspection of the building structure, digester system, and equipment items; provides repair recommendations of immediate concern; and provides recommendations for future repairs.

The Syracuse METRO WWTP Digester Control House was inspected on October 15, 2009 and again on November 18, 2009. There were three main objectives:

1. To determine any maintenance issues and repair recommendations that should be implemented in the Phase 1 digester cleaning project because of the necessity to complete the repair when the digester is out of service. These will be classified Priority 1 improvements.

2. To determine any maintenance issues and repair recommendations that should be implemented in Phase 2 of this project. (Phase 2 will address items that are in need of replacement, after the digesters have been put back in service). These will be classified Priority 2 improvements.

3. To determine any maintenance issues and repair recommendations that are of lower priority and may be implemented in the future. These will be classified Priority 3 improvements.

This inspection report discusses these improvements.

ISOLATION VALVES

Each digester has a number of plug valves associated with it which enable it to be isolated from the system. There are 11 sludge isolation valves including a single 3-way valve for each of Digesters 1 through 3. There are a total of 13 sludge isolation valves for Digester 4, including a single 3-way valve. Due to the location and isolating function of these valves, they can only be replaced when the digester is empty. Many of the valves have reached their expected useful life, and some of them leak. For these reasons, it is recommended that all isolation valves be replaced during Phase 1 when each digester is taken out of service, and thus are classified Priority 1 improvements.

Recirculation Line Isolation Valve

DIGESTER HEATING SYSTEM

The digester heating system includes the sludge recirculation pumps, the sludge heat exchangers, hot water heat exchangers, and hot water circulating pumps. The inspection results and recommendations are as follows.

Sludge Recirculation Pumps

There are three sludge recirculation pumps in the basement with a capacity of 700 gpm at 18 feet of total dynamic head (TDH). The pumps are recessed impeller pumps manufactured by Hayward Gordon and the motors are manufactured by Emerson Electric. These pumps have been in service less than 10 years. The work order history was reviewed on the Computer Maintenance Management System (CMMS) and revealed that each pump has had an average of two corrective maintenance issues per year since 2002. The majority of these issues were false seal water alarms, plugging, and run failure. Both pumps and motors appear to be in good condition, and plant operators did not indicate any other issues. Accordingly, this equipment is classified as Priority 3 improvements. However, the County has requested that these pumps be replaced in Phase 2.

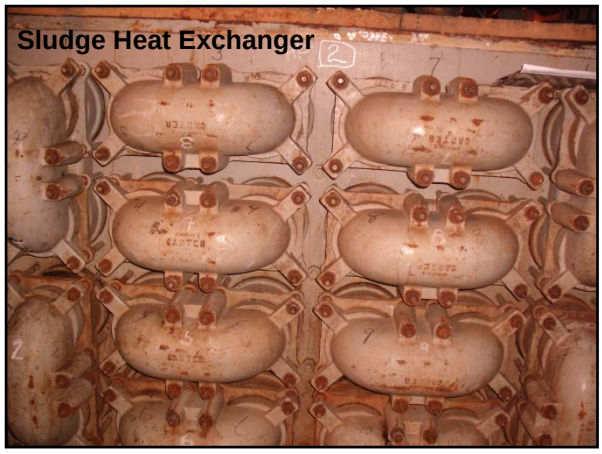
Sludge Heat Exchangers

There are three “tube and shell type” sludge heat exchangers in the basement, manufactured by the Ralph B. Carter Co. The design heating capacity is 1 million BTU/hour, the design sludge flow is 700 gpm at a pressure of 30 psig, and the design heated water flow is 300 gpm. The heat exchangers have been in service in excess of 35 years and are obsolete because the manufacturer is no longer in business and replacement parts are not readily available. The work order history was reviewed on the CMMS and revealed that these heat exchangers experience approximately two corrective maintenance issues per year. Due to the age of the equipment and unavailability of parts, it is recommended that all three sludge heat exchangers be replaced as part of Phase 2 and are classified as Priority 2 improvements.

Hot Water Heat Exchangers

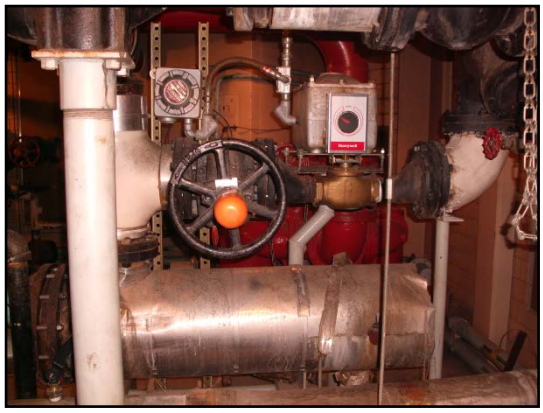
There are three hot water heat exchangers on the second floor, manufactured by the Carrier Corporation. These heat exchangers have been in service in excess of 35 years. Steam from the Plant Operations Building supplies heat to the hot water via these heat exchangers, which is then used for the sludge heat exchanger. The heat exchangers' insulation is deteriorating. The work order history was reviewed on the CMMS and revealed that the hot water heat exchangers experience about two corrective maintenance issues per year. The majority of these involve steam valve leaks, steam trap leaks, and low or high temperature. Due to the age of these heat exchangers, it is recommended that the heat exchanger and associated insulation be replaced in the Phase 2 improvements.

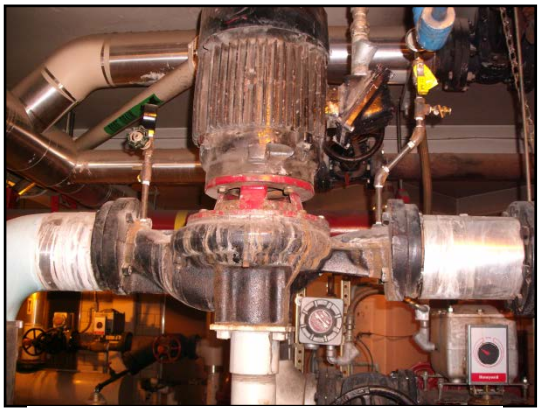

Recirculation Pump



Hot Water Recirculation Pumps

There are three hot water recirculation pumps on the second floor, manufactured by Bell & Gossett. The motor nameplate is illegible. These pumps have been in service in excess of 35 years. The pumps circulate hot water from the heat exchangers to the sludge heat exchangers. A visual inspection indicated seal leakage. A review of the work order history on the CMMS revealed that these pumps have had few corrective maintenance issues, but those that occurred involved seal leaking and line leaking. Due to the age of these pumps, it is recommended they be replaced as part of Phase 2, and are classified as Priority 2 improvements.


Hot Water Heat Exchanger


Hot Water Recirculation Pumps

DIGESTER GAS MIXING SYSTEM

The digester gas mixing system includes the gas suction piping and valves, 8-inch sediment traps, flame arresters, gas compressors, discharge piping and valves, balancing valves, draft tube (mixing gun), bubble generator, instrumentation and controls. This report identifies only the items inside the Digester Control House. The inspection results and recommendations of these items are as follows.

Piping

The gas piping from the primary digesters to the main gas header is an 8-inch carbon steel pipe. The main gas header is a 14-inch carbon steel pipe which is connected to the secondary digester (gas holder) and the boilers. Each compressor is fed off of this 14-inch header via an 8-inch carbon steel pipe. The discharge piping from the compressors to the balancing manifold was 6-inch carbon steel.

During construction of the Phase 1 repairs, it was discovered that the 6-inch carbon steel pipe discharge from the compressors was completely plugged with sludge. This pipe was immediately replaced with new stainless steel rolled groove piping during Phase 1. The main header and suction piping were also inspected and appeared to be in fair condition. However, there was a section of the Digester 2 gas pipe located on the second floor that had failed previously and was repaired with a pipe clamp. It is recommended that this section of pipe be replaced in Phase 2 along with the similar section of pipe for Digesters 1 and 3. The pipe shall be replaced with Schedule 10 stainless steel. The section of pipe recommended for replacement is shown in the photographs following this memorandum.

Isolation Valves

There were a total of 36, 2-inch isolation plug valves on the gas feed lines (12 per Digesters 1 through 3) and 36, 2-inch check valves (12 per Digesters 1 through 3) on the gas feed lines to prevent sludge backup. During construction, it was discovered that one or more of the check valves had failed and sludge had backed up to the compressors in each of the main 6-inch gas feed lines. Because of this, the mixing system was upgraded with the addition of a “Hartford Loop” on each gas feed line to each mixing gun (12 per digester). The Hartford Loop is simply a loop in the gas feed piping where the pipe ascends above the main water line and then descends to the mixing gun entry point, thereby physically eliminating the possibility of sludge backflow (without human interference) to the compressors. The addition of the Hartford Loop eliminates the need for the 2-inch check valves. Therefore, the check valves were not replaced.

Plant staff requested the ability to isolate each 6-inch gas manifold without having to shut down any compressors. Currently, one compressor must be shut down to isolate any of the 6-inch gas manifolds. Adding a new plug valve on the feed pipe to each 6-inch gas manifold would provide isolation without taking down a compressor. Installing a downstream purge port on each valve will also provide another location to purge the gas. It is recommended that three 6-inch plug valves be installed in the feed line of each 6-inch gas manifold. Since this work can only be done when a digester is taken out of service, it is recommended that it take place during Phase 1, and is classified as a Priority 1 improvement.

Sediment Traps

The gas is collected in the headspace of each primary digester. It is then piped to the Digester Control House for use. First, condensate and sediment is removed from the gas by a sediment trap for each primary digester. There are two sediment traps for each primary digester, located on the second floor of

the Digester Control House. The sediment traps are equipped with a drip trap to collect and remove the condensate. The sediment traps are made of carbon steel and appear to be in fair condition. However, they have been in service since approximately 1992 and because of their age and the longevity of the system, consideration should be given to replacing these units with new stainless steel traps in Phase 2.

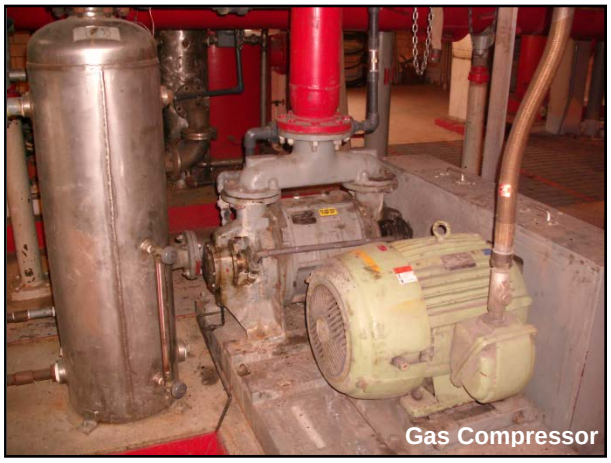
There are five additional 8-inch sediment traps located on the first floor which prevent sediment from entering the compressors. A low pressure manual drip trap (manufactured by Varec) is located at the base of each sediment trap which allows drain-off of condensation. The sediment and drip traps are approximately 17 years old. The sediment traps and drip traps appear to be in fair condition and operators did not indicate any maintenance issues. Based on age and longevity of the system, consideration should be given to replacing the sediment traps with new stainless steel traps. The drip traps are constructed of aluminum and appear to be in fair condition. Because they are constructed of a non-corrosive material, no recommendations are made at this time regarding the drip traps.

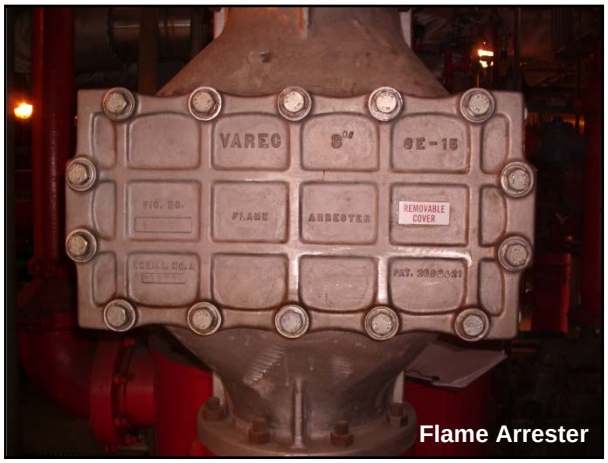
Flame Arresters

There are five flame arresters on the first floor, manufactured by Varec, which prevent flames from propagating through the gas compressor suction line. The flame arresters are approximately 17 years old. They appear to be in good condition and operators did not indicate any maintenance issues. The arresters are constructed of aluminum and have no moving parts. Therefore, no recommendations are made at this time with regard to the arrestors other than following the manufacturer's routine cleaning procedures.

Gas Compressors

There are five gas compressors (three active, two spare) on the first floor. They are liquid ring pumps, manufactured by Nash Engineering Co., and are approximately 17 years old. The compressor capacity is 370 SCFM at 14.2 psig. The 40 HP motors are manufactured by Emerson Electric. The compressors compress the digester gas before feeding it to the bubble generators on the gas mixing guns. Review of the work order history on CMMS revealed that these compressors experience an average of five to six corrective maintenance issues per year. The majority of these involve seal water ball valve cleaning, water leaking, repacking, difficult valve operation, seal water system issues, and belt replacements. Due to this and the fact that the compressors are nearing the end of their useful life, it is recommended that these units be replaced as part of Phase 2 and are classified as Priority 2 improvements.


Gas Compressor



Flame Arrester

Balancing Valves


Balancing Valves on Old Manifold

Each digester is equipped with its own gas balancing manifold and balancing valves to each mixing gun used to balance the gas flow between each mixing gun. The balancing valves were 2-inch DeZurik plug valves which have been in use for approximately 17 years. In addition to the balancing valves, each manifold was equipped with 12 isolation valves (also 2-inch plug valves from DeZurik). Plant operators stated some of these valves are inoperable. Some valve handles are broken. During construction, it was discovered that none of the 2-inch plug valves were operable and required immediate replacement.

It was also discovered that the method of flow measurement used (combination of orifice flange plates and manometer) for each 2-inch gas feed line was also inoperable. Therefore, a new method was also immediately required. Hence, in Phase 1, entire new balancing manifold assemblies were provided, equipped with new balancing and isolation valves (stainless steel ball valves were provided to replace the plug valves) and new rotameters for flow measurement.

Plant Water Valves

There are a total of 36, 2-inch plug valves on the plant water line that are used for flushing of the individual gas feed lines to each digester. These valves are approximately 17 years old. The plant operators stated these valves leak and should be replaced. It was recommended these valves be replaced in Phase 2 and were classified as Priority 2 improvements. However, these valves were replaced at the same time as the new manifolds were provided in Phase 1.

Gas Burners

There are three gas burners on the roof, manufactured by Varec. These burners have been in operation for approximately 12 years. Review of the work order records revealed that each gas burner experiences about three corrective maintenance issues per year. The majority of these involve the burners not being able to start or stop, replacing the thermocouple, and solenoid. The plant staff stated they were satisfied with the flares, but experienced problems with the ignition system. Due to the age and condition of this system, it is recommended that the ignition system be retrofitted or upgraded in Phase 2, and is classified as a Priority 2 improvement.

Other Valves

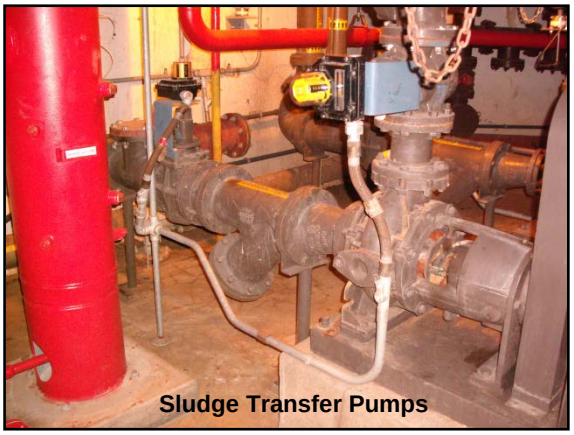
Other valves that are part of the gas mixing system are the suction gas header isolation valves, discharge gas header isolation valves, Vitaulic 6-inch motorized discharge plug valve, Crane 6-inch swing check valve (replaced during Phase 1), DeZurik 3-inch bypass plug valves (replaced during Phase 1), Crane 1-inch swing check valves, Crane 2-inch swing check valves (no longer required with the addition of the Hartford Loop), Varec backpressure check valve, Varec 1.5-inch flame check valve, and Fisher pressure relief valve. These valves are approximately 17 years old and appear to be in good working condition. The operators did not indicate any issues with these valves. Based on the age of this equipment, these valves should be replaced during Phase 2 with the gas compression equipment.

Instrumentation

The instrumentation associated with the gas mixing equipment includes an Allen-Bradley pushbutton control station for compressor control, seal water flow switches, temperature transducers, pressure gauges, pressure transducers, pressure regulators, seal water flow regulators, and remote Gould-Modicon control panel. The instrumentation is approximately 17 years old and appears to be in good condition. The plant operators did not indicate any issues. No recommendations are made at this time regarding the instrumentation. Upgrade of this instrumentation is classified as a Priority 3 improvement.

SLUDGE TRANSFER PUMPS

There are two sludge transfer pumps located in the basement, manufactured by Hayward Gordon, which have been in service for approximately 10 years. The 10 HP motors for these pumps are manufactured by Westinghouse Electric. The pumps' main operating point is 250 gpm at 71 feet TDH. Review of the work order records on the CMMS revealed that these pumps experience about one corrective maintenance issue per year, and these have primarily been minor issues. These pumps appear to be in good condition and plant operators did not indicate any major issues. The pumps can be isolated from the system and could be replaced at any time if necessary; therefore, they are classified as Priority 3 improvements.



Sludge Transfer Pumps

MISCELLANEOUS EQUIPMENT/ITEMS

Electrical Room

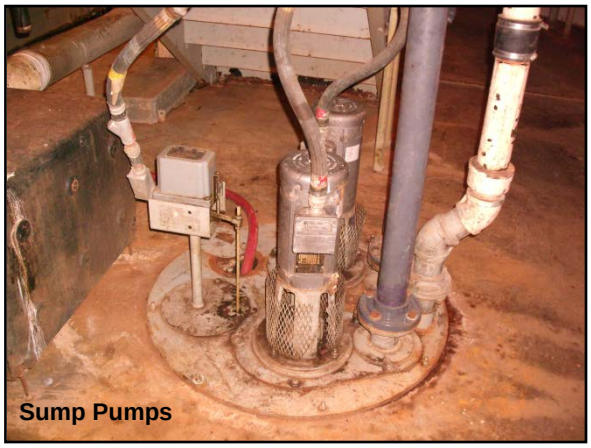
Equipment associated with the Electrical Room includes Digesters 1, 2, and 3 temperature controllers, water heater, gas monitoring system, waste gas burner controller, Waste Gas Burners 1, 2, and 3 totalizers, waste gas burner flow meter and totalizer equipment, and PLC M-08. All of this equipment appears to be in good condition and was working at the time of the inspection. The operators indicated there no maintenance issues in the Electrical Room. No recommendations are made at this time for equipment in the Electrical Room.

Sump Pumps

There is a duplex sump pump system in the basement. The sump pumps are manufactured by the Vertiflow Pump Company, and the motors are manufactured by Baldor Electric Company. These pumps have been in service for approximately 20 years. The sump pumps appear to be in good condition. The operators did not indicate any issues, nor did the work order records. Accordingly, this equipment is classified as a Priority 3 improvement.

Condensate Pump

The condensate pumps/receiver are located in the basement. The pumps are manufactured by ITT Flygt. At the time of the inspection, one pump was removed from service for repair and will be replaced. The pumps have been in service in excess of 35 years. Review of work records revealed the condensate pumps experience approximately three corrective maintenance issues per year, the majority of which are to repair the seals. Due to the age and condition of the condensate pumps, it is recommended they be replaced in Phase 2, and are classified as Priority 2 improvements.


Sump Pumps


Condensate Pumps

Pipe Tunnels

The pipe tunnels from the Digester Control House to each digester were viewed from the hatch above. The tunnels are infiltrated with groundwater. Further evaluation must be done to determine the extent of this problem and to identify potential improvements. It is recommended that this evaluation be included in the Phase 2 project scope of work.


Pipe Tunnel

Glycol System

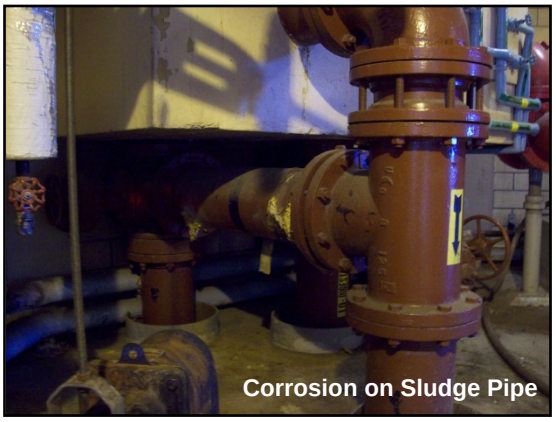
The 8-inch sludge gas line and the supernatant lines all have freeze protection consisting of a 3/8-inch hot water line with glycol solution that runs along the outer edge of pipe and is contained inside the pipe insulation. This system is believed to be over 35 years old. The system is recirculated by a pump on the second floor of the Digester Control House. This pump circulates the hot water/glycol through 4-inch lines. All of the insulation that surrounds the 4-inch hot water feed and return lines is asbestos. Due to the age of this system, the inability to maintain the piping because of the asbestos insulation, and the health concern of the asbestos, it is recommended this system be replaced in Phase 2, and is considered a Priority 2 improvement.


Glycol System

Pipe Corrosion

There was some corrosion on the supernatant sludge piping and on the insulation jacket to the 6-inch gas feed piping. The reason for the corrosion is unknown. Before a recommendation can be made, further evaluation of the cause of corrosion must be completed. This 6-inch gas feed pipe was replaced during Phase 1 and the insulation removed.

Corrosion on 6-Inch Gas Pipe Insulation



Corrosion on Sludge Pipe

Fiberglass Piping

There is some fiberglass sludge piping that cannot be maintained in house by plant maintenance staff, and any work involving the fiberglass piping must be outsourced. Due to this fact, replacing the fiberglass sludge piping in Phase 2 should be considered.

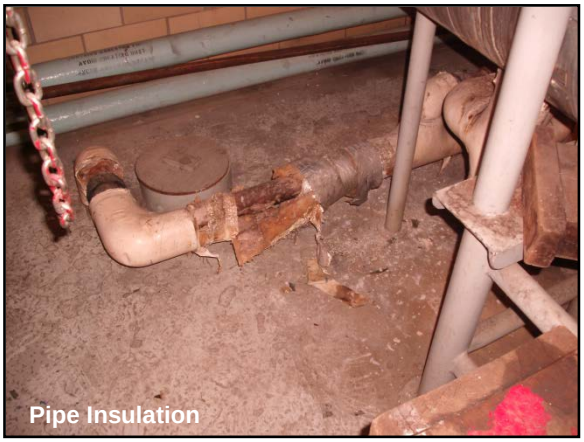
Piping Insulation

Much of the plant water pipe insulation has deteriorated. This insulation was identified by plant staff as fiberglass and will be repaired in house by County staff.

Exterior Pipe Insulation

Digester supernatant overflow pipes and digester gas pipes are exterior to the Digester Control House. The insulation jackets around these pipes are deteriorating. This may also result in a deterioration of the insulation. It is recommended that the insulation jackets be relaced and the quality of the insulation and pipe be checked. This work can be done at any time and is recommended for Phase 2, and is therefore classified as a Priority 2 improvement.


Exterior Pipe


Pipe Insulation

BUILDING STRUCTURE

The building was originally constructed around 1950 as a glazed masonry structure of octagon shape in plan view. The structure consists of two stories and a basement level and rooftop penthouse. At the roof level, steel bridge platforms lead out to each of the four digesters. In the basement level, two underground tunnels connect this building to other structures on the site. Inside the building, the floor levels are clear open space with interior partition walls only around the Control Room, which has an exterior access door. The floors are constructed as reinforced concrete slabs and a steel stair provides access between floor levels.

It is our understanding that the following modifications have been made since the original construction:

1. Vertical galvallum (metal) siding was installed over the building exterior around the mid-1980s. This siding has no insulation backing.

2. The main roof was replaced with a typical roofing membrane system in the 1990s.

3. The HVAC and unit make-up fans were updated in the early 1990s.

4. The penthouse roof was recently replaced with an inverted roofing membrane assembly.

The scope of services for this Inspection Report did not include a Building/Design Code review, and therefore this review was not completed; however, during inspection, one Design Code issue was identified. This was the improper sealing of the conduit to the Electrical Room. This issue is further described in the following section along with our recommendation.

Building Exterior Envelope

The vertical siding appears to be in fair to good condition for its age. The siding has some minor dents and other slight physical damage. The paint is faded and some of the rivets are rusted.

From the interior, it appears that about 75 percent of the windows were covered over when the metal siding was installed. Solid panels were installed on the interior, so it cannot be determined if the existing windows remain. The exposed windows are single-pane glass with metal frames. They are in

poor condition with cracked glass and aged hardware. It is recommended that more of the covered window locations be opened up to allow more natural light in, and all existing windows should be replaced with new energy efficient windows. This work should be classified as Priority 2 improvements.

The existing doors are in fair condition with damage and wear of the paint, hardware, and weatherstripping. We recommend that repair of the exterior doors be classified as Priority 2 improvements.

The main roof appears to be in good condition for being about 15 years old. Membrane roofs are typically replaced about every 20 to 25 years; a roof replacement should be scheduled in the next 5 to 10 years, and is classified as a Priority 2 improvement.

The condition of the penthouse roofing system cannot be assessed due to its assembly. It is reasonable to assume that the roof system is in very good condition due to its age. Upon our inspection, it was discovered that runner crush (stone) material was used as ballast on this roof. Since this runner crush has sharp edges, there is a potential that it could tear into the exposed flashing material. Also, the runner crush material tends to compact, which would limit the drainage through the stone. It is recommended this runner crush material be replaced with the conventional round stone used for roof ballast. Due to the potential of the runner crush causing damage to the new roofing system, the replacement of the ballast should be classified as a Priority 2 improvement.

An aluminum platform with ladders are located on the exterior north wall. Both items are in good condition, and no work is recommended at this time.

Building Interior

The concrete floors/ceilings are in good condition, but the paint is in poor condition due to typical wear. The steel grating on the first floor that covers an approximate 7-foot by 14-foot floor opening is functional but has some minor damage. The glazed walls are also in good condition, but patches in the walls due to replacement of equipment and other markings should be repaired. It was also noticed that the wall penetrations (around conduits) into the Control Room are not completely sealed off. The wall penetrations into the Control Room need to be completely sealed off due to its explosionproof classification. Due to the potential hazard of this condition, this should be classified as Priority 1 improvements.

There is also an interior door to the Electrical Room that was used before the conversion of the bathroom into the Electrical Room. In order to separate the areas, this door was sealed off when the bathroom was converted. It is recommended this door be checked to determine if it is gas-tight; if not, it should be resealed or modified to result in a gas-tight wall. This work should be done in Phase 1.

We recommend the floors and ceilings be cleaned and repainted; the walls should be cleaned, patched, sanded, and repainted. The steel grating should be replaced with new galvanized grating. All this work should be classified as Priority 2 improvements.

In the basement, the floors and walls are in overall good condition. Some existing floor patches that are starting to crack and come out should be repaired with new patching mortar. There appears to be a leaking joint at the north tunnel junction. This joint should be investigated and repaired with sealant and/or patching mortar. At the base of the stairs, a pipe is partially embedded in the concrete floor.

Since this pipe could be a tripping hazard, it should either be re-routed overhead or be embedded completely below the floor surface. All this work should be classified as Priority 2 improvements.

The metal stairs are in good condition, but should be repainted. Condensate receiver equipment below the stairs in the basement has started to cause corrosion on the underside of the stairs due to build-up of condensation. This equipment could be considered for relocation. The condensate receiver vent pipe should be relocated. This work should be classified as Priority 2 improvements.

Bridge Platforms (Walkways)

The steel bridge platform (walkway) structures are in good condition, but the coating (paint) is in fair condition with spots of minor corrosion coming through. It is our understanding that these walkways were disassembled and repainted about 10 to 15 years ago. These walkways should be sandblasted and repainted as a Priority 3 improvement to help defer the onset of corrosion.

COST OF IMPROVEMENTS

Table 1 summarizes the replacement recommendations. Table 2 includes the associated costs of the Priority 1 improvements, and Table 3 includes the associated costs of the Priority 2 improvements.

(continued)

TABLE 1

IMPROVEMENTS

EQUIPMENT/MATERIAL	QUANTITY	APPROXIMATE AGE (YEARS)	CONDITION
Priority 1 Improvements			
Replace 6-inch digester isolation plug valves	20	37	Poor
Replace 8-inch digester isolation plug valves	22	37	Poor
Replace 8-inch digester isolation 3-way plug valves	4	37	Poor
Add new 6-inch gas header isolation plug valves	3	N/A	N/A
Sealing of wall penetrations to Control Room	N/A	N/A	Poor
Replacement of balancing manifold assemblies	3	17	Poor
Priority 2 Improvements			
Replacement of sludge heat exchangers	3	35	Fair
Replacement of hot water heat exchangers	3	35	Fair
Replacement of condensate pumps and motors	2	35	Poor
Replacement of 3-inch isolation valves on plant water header	3	17	Fair
Replacement of gas compressors	5	17	Poor
Replacement of other gas mixing system valves	Multiple	17	Good
Replacement of sediment traps	11	17	Fair
Replacement of gas burners ignition system	3	12	Fair
Replacement of hot water circulating pumps	3	37	Fair
Replacement of penthouse roof ballast	N/A	15	N/A
Replacement of glycol system	1	35	Fair
Replacement of exterior pipe insulation jacket	All	35	Poor
Miscellaneous painting/patching walls, floors, ceilings	N/A	N/A	Poor
Replacement of windows	Unknown	60	Poor
Repair of exterior doors	N/A	60	Fair
Relocate condensate receiver vent	1	35	N/A
Replacement of carbon steel gas piping with stainless steel	~400 LF		Fair
Replacement of main roof	N/A	15	Good
Priority 3 Improvements			
Replacement of sludge recirculation pumps	3	8	Good
Replacement of sludge transfer pumps	2	8	Good
Replacement of gas mixing instrumentation	Multiple	17	Good
Repair of leaking joint in tunnel	N/A	N/A	Poor
Painting stairs	N/A	N/A	Good
Replacement of sump pumps	2	20	Good
Sandblasting and repainting of bridge walkways	N/A	N/A	Good

TABLE 2

PRIORITY 1 IMPROVEMENT ACTUAL COSTS

EQUIPMENT/MATERIAL	QUANTITY	INSTALLED COST
Replace 6-inch digester isolation plug valves	20	$28,000
Replace 8-inch digester isolation plug valves	22	$32,000
Replace 8-inch digester isolation 3-way plug valves	4	$25,000
Addition of 6-inch digester gas isolation plug valves	3	$28,000
Sealing of wall penetration to Control Room	N/A	Negligible
Replacement of balancing manifold assemblies	3	$177,000
Replacement of 6-inch compressor discharge gas piping	100 LF	$92,000
TOTAL		**$382,000**

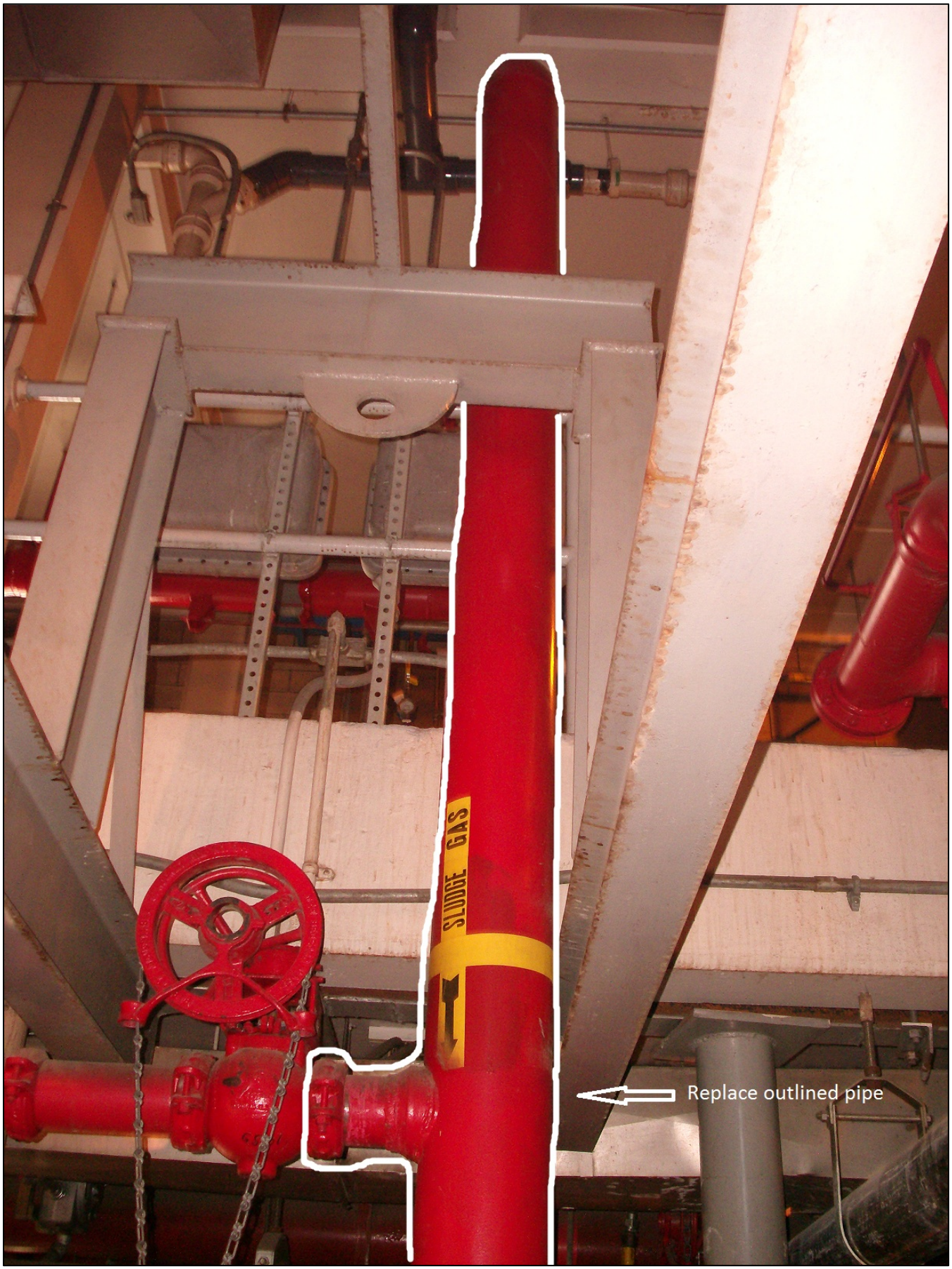
TABLE 3

PRIORITY 2 IMPROVEMENT COSTS

EQUIPMENT/MATERIAL	QUANTITY	MATERIAL COST	INSTALLED COST
Replacement of sludge heat exchangers	3	$225,000	$320,000
Replacement of sludge recirculation pumps(1)	3	$120,000	$160,000
Replacement of hot water heat exchangers	3	$75,000	$110,000
Replacement of condensate pumps and motors	2	$9,000	$13,000
Replacement of 8-inch carbon steel gas piping with stainless steel	90 LF	$70,000	$100,000
Replacement of gas compressors	5	$265,000	$400,000
Replacement of other gas mixing system valves(2)	Multiple	$106,000	$150,000
Replacement of sediment traps	11	$105,000	$130,000
Replacement of waste gas burners and ignition system(3)	3	$154,000	$210,000
Replacement of hot water circulating pumps	3	$24,000	$36,000
Replacement of penthouse roof ballast	N/A	$500	$2,000
Replacement of glycol system(4)	1	$6,300	$10,000
Replacement of exterior pipe insulation jacket	All	$7,200	$12,000
Miscellaneous painting/patching walls, floors, ceilings	N/A	$4,200	$21,000
Replacement of windows	~30	$60,000	$86,000
Repair of exterior doors	~3	$500	$3,000
Relocate condensate receiver vent	1	$200	$1,000
Repair leaking wall penetrations for 2-inch gas feed pipe in basement	9	N/A	$2,000
Replace Digester Control House main roof(5)	1,600 SF	$25	$40,000
Miscellaneous mechanical(6)	1	N/A	$100,000
Electrical			$150,000
Demolition			$100,000
Subtotal			$2,200,000
General Conditions (8%)			$180,000
Mobilization (5%)			$110,000
Construction Contingency (25%)			$550,000
Contractor's Overhead and Profit (20%)			$440,000
Total Construction Cost			$3,500,000
Engineering and Administrative (20%)			$700,000
TOTAL PROJECT COST			**$4,200,000**

(1) Per Owner request.
(2) This item includes replacement of (a) five 8-inch low pressure check valves; (b) three pressure relief flame trap assemblies (on waste gas burner lines); and (c) six flame checks
(3) Includes burners and ignition system, and electronic controls package.
(4) Installation of heat tracing is proposed to replace the glycol system.
(5) Material cost includes labor.
(6) Includes replacement of overflow box piping.


SLUDGE GAS
Replace outlined pipe


SLUDGE GAS
Replace outlined pipe


SLUDGE
Replace Pipe Outlined


Replace Pipe Outlined
2