United States Steel Corporation
Midwest Plant
Portage, Indiana

Enhanced Wastewater Process Monitoring Design

06-29-2018

Contents

Appendices

I. Introduction

This Enhanced Wastewater Process Monitoring Design plan satisfies the requirements of the Evaluation (11.a) and Design (11.b) of the Enhanced Wastewater Process Monitoring System section of the 2018 Midwest Consent Decree dated April 2, 2018.

U. S. Steel evaluated the Midwest Plant Facility (Midwest) as per Part 11.a of the Midwest Consent Decree which states:

> *By no later than March 30, 2018, U. S. Steel shall complete an evaluation of the existing wastewater process monitoring at its Midwest Plant Facility. The evaluation shall include an investigation of enhanced monitoring technologies and equipment for early detection of conditions that may lead to spills such as the April 11, 2017 Spill, and conditions that may lead to unauthorized discharges or discharges in exceedance of Permit limits, at the wastewater treatment works.*

U. S. Steel then developed a Design based on the results of the evaluation and pursuant to Part 11.b of the Midwest Consent Decree which states:

> *By no later than three (3) months after completing the evaluation specified in subparagraph a. above, U. S. Steel shall submit to EPA and IDEM for review and approval, in accordance with Section VII (Review and Approval of Submittals), a design for enhanced wastewater process monitoring for early detection of conditions that may lead to spills such as the April 1, 2017 Spill, and conditions that may lead to unauthorized discharges or discharges in exceedance of Permit limits, at the wastewater treatment works.*

This document summarizes the evaluation and design of the Enhanced Wastewater Process Monitoring System for Midwest. The facility was evaluated with regards to the April 11, 2017 spill, unauthorized discharges, and the potential of discharges to exceed permit limits. The design was developed from documented technologies and equipment, but may change based on actual performance of equipment once installed.

II. April 11, 2017 Spill

The April 11, 2017 spill was investigated and evaluated to determine root cause and preventative actions to reduce the possibility of a similar incident happening in the future. The following corrective actions were identified and are included in the Enhanced Wastewater Process Monitoring System design:

II.A. Chrome containment trench refurbishment

To address the integrity of the containment trench for the chrome process wastewater piping, the trench was cleaned, and new concrete bottom poured. The trench slope was reestablished to direct any flow in the trench to the chrome trench sump. Please see Figure 1 and Figure 2 in Appendix 1 for the location of the trench.

A protective epoxy coating was installed over all of the concrete in the trench. A total of three layers were installed. The inner-most primer layer is for proper bonding, then a coating of a

chemical resistance epoxy applied in 2 layers to establish a thickness for better service wear. The epoxy coating is chemically compatible with the process water and will prevent deterioration of the concrete.

II.B. Install flow meters on chrome wastewater piping

Two flow meters were installed at the inlet and outlet areas of the chrome plant influent wastewater piping. The pipe entry flow meter is located just after the combining of chrome wastewater flows from the Tin and Chrome Lines basement sumps and the pipe delivery flow meter is located just prior to discharge into the chrome plant equalization tank. Both installation locations were selected to minimize any hydraulic effects that may contribute towards accuracy errors. The pipeline is continuous and does not have any tie-ins along the length between the flow meters. Please see Figure 1 and Figure 2 in Appendix 1 for the location of the pipe entry and pipe delivery flow meters.

The flow meters were installed with the intent to monitor and compare the flow data, and to initiate an alarm signal in the event a preset flow discrepancy is exceeded. Flow data continues to be collected, but the results thus far have shown a wider range in flow indications than expected. The magnitude of the difference is variable and cannot reliably indicate a smaller leak. The flow meters will be better optimized, if possible, and will continue to be monitored to indicate larger leaks from the pipeline.

II.C. Install conductivity meter in chrome trench sump

A conductivity probe will be installed in the chrome trench sump to identify potential process water leaks into the trench. A higher ionic concentration, and therefore conductivity, is expected in a process wastewater as opposed to a stormwater source. Currently, there is no visual method to differentiate between storm water and process water presence in the trench. Once installed, the probe will be tied to the plant alert/alarm system. An acceptable conductivity action level will be determined based on an ongoing analysis of the normal readings. The conductivity monitoring will be in addition to the operators' visual check of the sump.

II.D. Develop procedure for operator testing of chrome trench sump

The chrome plant operator will conduct a colorimeter benchtop test for hexavalent chromium on a sample from the chrome trench sump once per day. U. S. Steel will analyze the ongoing results to determine the concentration at which an operator will initiate investigative action. If needed, the operator will shut down the potentially contributing process lines to minimize the spike of hexavalent chromium concentration, and adjust the chemical feed and/or flow rate through the plant in order to maintain proper treatment.

II.E. Install high level alarm float in chrome trench sump

A new high-level alarm will be installed in the chrome trench sump and will be tied into the plant alert/alarm system. The operator will then take the appropriate action in response to an alarm, which may include the shutdown of any process lines if they are contributing to the high level. Maintenance will investigate the cause of the high volumetric level in the trench sump and initiate repairs.

II.F. Manual testing of Final Treatment Plant discharge

The final treatment plant operator will conduct hexavalent chromium tests using a benchtop colorimeter on the final treatment discharge once per day in addition to the third party NPDES testing. U. S. Steel will analyze the ongoing results to determine the concentration at which an operator will initiate investigative action. If needed, the operator will shut down the potentially contributing process lines.

II.G. Trial and Install Inline Hexavalent Chrome monitoring

U. S. Steel conducted a trial with an Aqua Metrology Systems MetalGuard™ automated online analyzer on the discharge of the Chrome Treatment Plant. The approximately two-month trial was performed to determine the ability of the inline meter to detect low levels of hexavalent chromium for an early warning of a possible concentration increase above the normal operating range. The results of the analyzer were inconsistent when compared to third-party analysis of a split sample. As part of the trial, U. S. Steel spiked the reservoir of the analyzer with a known concentration of hexavalent chromium to determine if the instrument would be more accurate above the operating range. The results were inconsistent in this higher concentration range as well. In addition to the concentration inaccuracy, the small sample ports would become plugged with trace amounts of solids and would take the unit offline until cleaned. U. S. Steel determined from the inconsistent results and unreliable operation that the MetalGuard™ analyzer is not appropriate for installation at the Chrome Treatment Plant.

U. S. Steel then contacted ASA Analytics (ASA) to begin a trial of a ChemScan® mini process analyzer (ChemScan). The trial began with bench scale testing in the ASA laboratory using samples from the Midwest Plant Chrome Treatment Plant discharge, Final Treatment discharge, and non-contact cooling water from the Chemtreat and Plater section heat exchangers of the Chrome Process Line. The ChemScan unit's larger sample ports did not experience plugging, and the concentration in the samples other than the Chrome Plant discharge well-matched third party analytical concentration tests. The Chrome Plant may be experiencing interferences that continue to be investigated.

U. S. Steel has obtained a ChemScan unit for onsite trialing. The unit may be placed in the following locations, pending successful trial:

1. Final Treatment Plant (Internal Outfall 104)

   The discharge of the Final Treatment Plant will undergo a trial of the ChemScan unit to determine the accuracy in measuring hexavalent chromium presence. The Chemscan unit will be placed at the discharge rather than an upstream location to minimize interferences and perform the measurement on the less contaminated wastewater. The trial will determine the optimal location for the unit.

2. Chrome Treatment Plant (Internal Outfall 204)

   Upon a successful trial at the Final Treatment Plant, a ChemScan unit will be trialed at the discharge of the Chrome Treatment Plant to determine the optimal location for the sample to be withdrawn.

3. Outfall 004

A Chemscan unit is not planned for trial at Outfall 004. The upstream monitoring will be able to detect hexavalent chromium at a lower level, and provide a more accurate indication as to the area of the source.

II.H. Install inline spare conductivity meter in chrome basement sump

An inline spare probe will be installed near the sump pumps to provide additional monitoring. The two conductivity probes will be tied to the plant alert/alarm system. Both probes are installed to alarm in the event a process water release is detected. A high concentration will automatically initiate a shutdown of the sump pumps. The appropriate alarm levels will be determined from concentrations above the normal process discharge range.

II.I. Chrome Evaporator High Level Alarm

An evaporator for the chrome line will have two new guided wave level sensors installed to replace the current level pressure sensor. Solids buildup on the current level pressure sensor could cause improper level detection and potentially prevent the drain valve from opening and overflow the evaporator to subsequent tanks and on to the chrome basement sump. The new high-level sensors will detect if the volume of process water in the evaporator approaches an overflow condition. The following will automatically occur in response to an alarm:

1. Open the level-control return valve to discharge the solution back to the evaporator feed tank
2. Break the vacuum of suction drawing solution through the evaporator
3. Shut down the feed pumps at the inlet to the evaporator
4. Alert Operations to the problem

III. Unauthorized discharges

The Midwest facility was assessed as to potential risks associated with unauthorized discharges. The following action items were identified and are included in the Enhanced Wastewater Process Monitoring System:

III.A. Eliminate Tin Line delivery looper pit drain to Final Treatment

A drain was identified in the delivery looper pit of the Tin Line that discharged to the Final Treatment Plant. Rerouting this drain will ensure that all material collected in the looper pit will be pumped to the chrome treatment plant. Please see Figure 1 and Figure 2 in Appendix 1 for the location of the modified piping from the looper pit.

III.B. Refurbish containment around chrome heat exchangers and coat with epoxy

The containment around the Plater and ChemTreat heat exchangers will be refurbished to prevent any unplanned release from migrating from the area. Please see Figure 1 and Figure 2 in Appendix 1 for the location of these heat exchangers.

III.C. Replace centrifugal chrome pumps in the chrome line basement with sealed mag-drive design

The seals/packing glands on centrifugal pumps are prone to wear and potential process water leaks. The sealed mag-drive design eliminates the seal leaks.

III.D. Refurbishing and coating of chrome basement trench

Refurbishing the chrome basement trench will ensure containment is secure and will prevent possible releases to the environment. The integrity of the basement trench will be restored with new concrete and epoxy in areas where needed.

III.E. Purchase new laboratory equipment for hexavalent chromium testing

A new photo spectrometer will provide the process control sampling capability for the Midwest Laboratory to analyze wastewater samples for hexavalent chromium reliable down to the detection needed to identify potential problems. This instrument will be in addition to the ICP and IC units that are currently in use at the Midwest Laboratory.

III.F. Manhole in Tin Annex

The Tin Annex contains an offline pickle cleaning solution (sulfuric acid) and a neat hydrochloric acid tank. Concrete around the top of manhole DIW 19 that discharges to the DIW process sewer has eroded and could allow migration of these acids to the Final Treatment Plant. This manhole in the Tin Annex will be permanently sealed. This will allow any tank leak to be fully contained. A vacuum truck will remove any accumulated material. Please see Figure 1 and Figure 2 in Appendix 1 for the location of manhole DIW 19.

III.G. Install inline spare conductivity meter in Tin Line basement sump

An inline spare probe will be installed near the sump pumps to provide additional monitoring. The two conductivity probes will be tied to the plant alert/alarm system. The probes will be installed to alarm in the event a process water release is detected. A high concentration will automatically initiate a shutdown of the sump pumps. The appropriate alarm levels will be determined from concentrations above the normal process discharge range. Please see Figure 1 and Figure 2 in Appendix 1 for the location of the Tin Line basement sump.

IV. Discharge in exceedance of Permit Limits

The Midwest facility wastewater treatment facilities were assessed as to the potential of discharges to exceed NPDES permit limits. The following actions items were identified and are included in the Enhanced Wastewater Process Monitoring System:

IV.A. Install additional inline turbidity meters on chrome plant lamellas

The lamella plates in the Chrome Plant remove chrome bearing solids from the treatment stream. There are three discharge channels from the separation plates of the lamellas. There was a turbidity probe in only one of the three discharge channels of each train. This prevented detection of solids discharging from the other two channels. Additional inline turbidity meters

were recently installed in the other two channels of each train to measure the solids carryover across all three channels. Each of the six turbidimeters are tied into the plant alert/alarm system and can initiate an alarm independently.

IV.B. Install additional access platforms to aid in chrome plant lamella inspection and cleaning

The original access points to clean and inspect the lamella plates did not provide a safe access the entire width of the equipment. By adding additional access platforms at the effluent troughs, the operator can now safely perform maintenance and cleaning activities.

IV.C. Replace single wall spiral heat exchangers with double wall plate and frame heat exchangers

A single wall plate and frame heat exchanger on the Chrome Line Plater section, and two spiral heat exchangers on the Chrome Line ChemTreat section were replaced with double wall plate and frame heat exchangers. The double wall heat exchangers significantly reduce the likelihood of process water leaking into the non-contact cooling water.

IV.D. Daily testing of Chrome Line heat exchangers for leaks

Samples of non-contact cooling water from each chrome line heat exchanger will be taken and analyzed at Midwest's laboratory for hexavalent chromium once per day. U. S. Steel will determine an action level for reanalysis of a sample, increased sampling frequency as part of an investigation. If a potential leak is confirmed the operating heat exchanger will be removed from service and a backup unit placed in operation and tested.

IV.E. Investigate and trial online hexavalent chromium monitoring for chrome heat exchangers

Pending a successful trial at the Final Treatment plant discharge, examine the feasibility of installing inline hexavalent chromium monitoring on the discharge water lines of Chrome heat exchangers.

1. Chemtreat heat exchangers (or divert to chrome plant)

   The Chemtreat section of the chrome line requires cooling across a double walled heat exchanger. The non-contact cooling water flow is fairly low, and could potentially be redirected to the Chrome Treatment Plant instead of the Final Treatment Plant. If not redirected, a trial will be conducted at this heat exchanger's discharge to determine if inline hexavalent chromium monitoring is appropriate.

2. Plater heat exchangers

   The Plater section of the Chrome Line also requires cooling across a double walled heat exchanger as well. The higher flow rate of this cooling water cannot be redirected to the Chrome Plant. The ChemScan unit will be trialed and evaluated to determine if hexavalent chrome monitoring is appropriate.

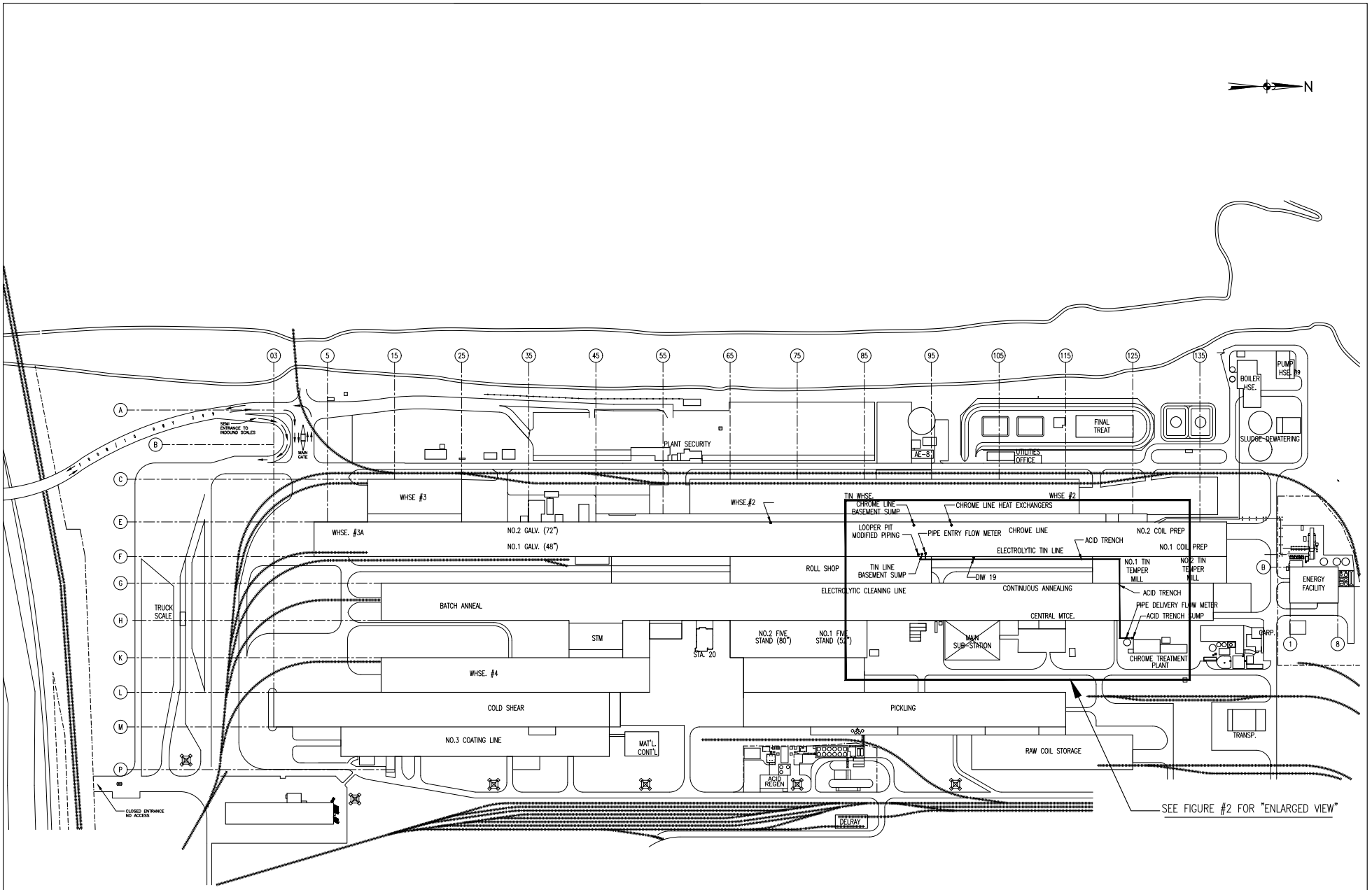
IV.F. Investigate Electronic Alert and Alarm System Integration at Final Treatment

The Final Treatment Plant alerts and alarms are localized at the plant. Several treatment steps rely on operator knowledge and awareness to notice drifts outside of the normal process range. U. S. Steel will investigate methods for incorporating electronic outputs into the plant-wide alert system, and record trending data to assist in process control.

Appendices

Appendix 1

Facility Drawings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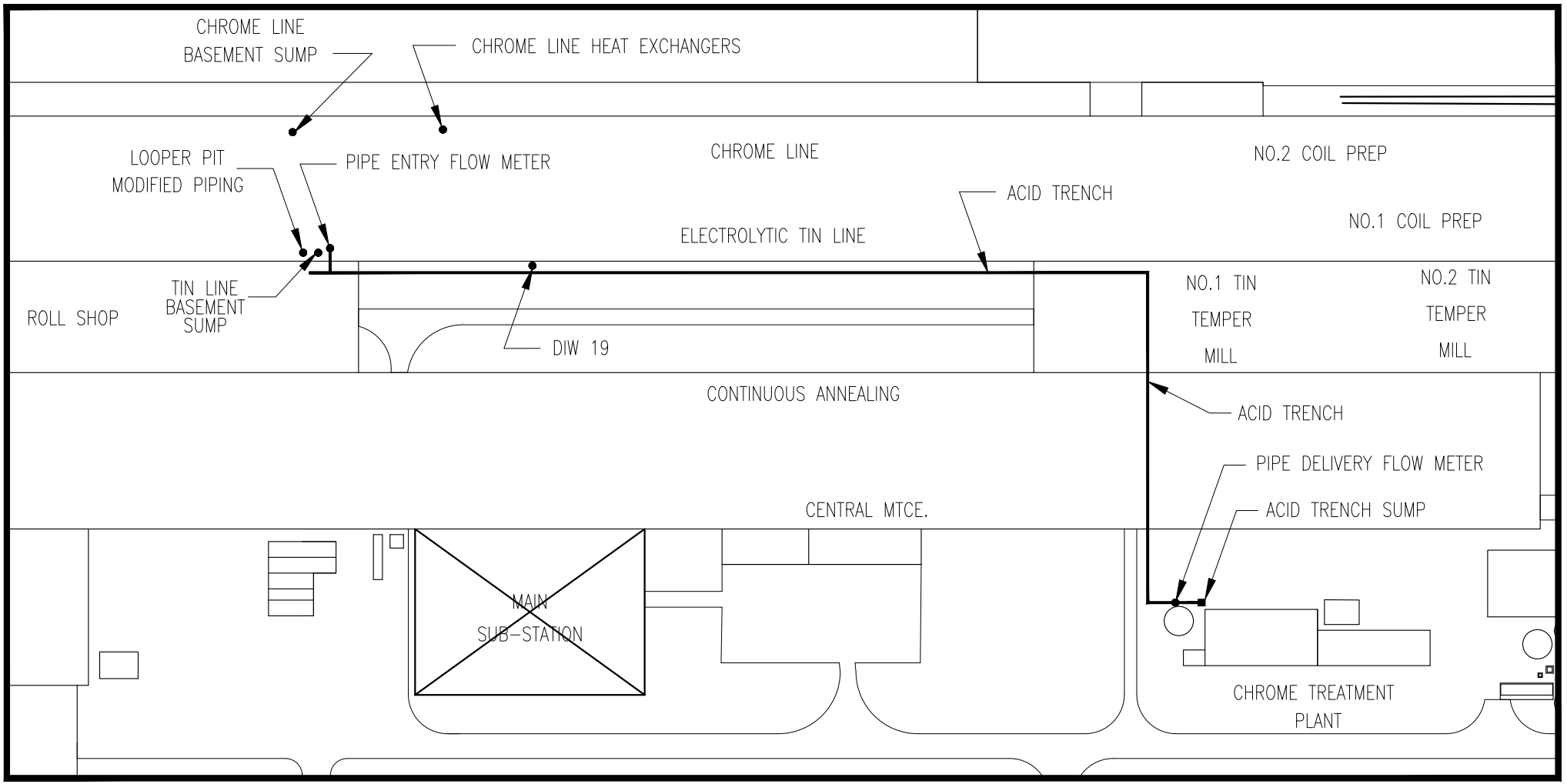
SEMI ENTRANCE TO INBOUND SCALES
MAIN GATE
PLANT SECURITY
AE-8
UTILITIES OFFICE
FINAL TREAT
BOILER HSE.
PUMP HSE. 89
SLUDGE DEWATERING
WHSE #3
WHSE. #3A
WHSE.#2
TIN WHSE.
WHSE #2
CHROME LINE BASEMENT SUMP
CHROME LINE HEAT EXCHANGERS
LOOPER PIT MODIFIED PIPING
PIPE ENTRY FLOW METER
CHROME LINE
NO.2 COIL PREP
NO.1 COIL PREP
ACID TRENCH
ELECTROLYTIC TIN LINE
NO.2 GALV. (72")
NO.1 GALV. (48")
ROLL SHOP
TIN LINE BASEMENT SUMP
DIW 19
NO.1 TIN TEMPER MILL
NO.2 TIN TEMPER MILL
ENERGY FACILITY
ELECTROLYTIC CLEANING LINE
CONTINUOUS ANNEALING
ACID TRENCH
PIPE DELIVERY FLOW METER
ACID TRENCH SUMP
TRUCK SCALE
BATCH ANNEAL
CENTRAL MTCE.
STM
STA. 20
NO.2 FIVE STAND (80")
NO.1 FIVE STAND (52")
MAIN SUB-STATION
GARP.
CHROME TREATMENT PLANT
WHSE. #4
COLD SHEAR
PICKLING
NO.3 COATING LINE
MAT'L. CONT'L
TRANSP.
RAW COIL STORAGE
ACID REGEN
DELRAY
CLOSED ENTRANCE NO ACCESS
SEE FIGURE #2 FOR "ENLARGED VIEW"

FIGURE #1


CHROME LINE
BASEMENT SUMP
CHROME LINE HEAT EXCHANGERS
LOOPER PIT
MODIFIED PIPING
PIPE ENTRY FLOW METER
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ACID TRENCH
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ACID TRENCH
PIPE DELIVERY FLOW METER
CENTRAL MTCE.
ACID TRENCH SUMP
MAIN
SUB-STATION
CHROME TREATMENT
PLANT

FIGURE #2