CALL FOR BIDS
CITY OF MINNEAPOLIS
M I N N E S O T A

Official Publication No. 8313

June 21st, 2016

PURCHASING DEPARTMENT
330 Second Avenue South - Suite 552
Minneapolis, MN 55401

AN AFFIRMATIVE ACTION EMPLOYER

P/W – Water Treatment and Distribution Services

For information call
Ashley Matuke, (612) 673-3371
Ashley.Matuke@minneapolismn.gov

"BIDS FOR PROGRAMMABLE LOGIC CONTROLLER"

To provide all materials, labor, equipment and incidentals necessary for upgrading the Programmable Logic Controller for the City of Minneapolis, all in accordance with the provided specifications and bid form.

Complete project documents are available for electronic download at the following link:

http://www.minneapolismn.gov/finance/procurement/bidopenings/formal

All addendums can be found online; please check the above website BEFORE submitting your completed bid response.
It is the Contractor's full responsibility to ensure they have received all addenda prior to the submittal of bids.

Please e-mail questions concerning this solicitation to ashley.matuke@minneapolismn.gov. Questions received later than 8 days prior to bid opening may not be addressed.

No pre-bid meeting will be held.

Successful bidders with cumulative contracts exceeding $50,000 will be required to submit a written affirmative action plan (AAP) to the Minneapolis Department of Civil Rights (MDCR) in accordance with Chapter 139.50(b) of the Minneapolis Code of Ordinances.

The successful bidder shall be subject to a pre-award compliance review by the MDCR in accordance with Chapters 139.50 and 423. In addition to the pre-award review, MDCR will also monitor SUBP participation, minority and female employment participation and prevailing wage throughout all construction projects. As of May 1, 2012 the employment goals for onsite labor on all city construction contracts are 6% female and 32% minority. Employee hours and wages are required to be filed electronically with a free online account at LCPtracker.net. Information regarding Frequently Asked Questions (FAQs) may be found on the web at www.ci.minneapolis.mn.us/civilrights/contractcompliance/faq. Questions may be directed to the Department of Civil Rights at contractcompliance@minneapolismn.gov.

The City of Minneapolis hereby notifies all bidders that in regard to any invitations to bid, advertisements, solicitations, or contracts to be entered into pursuant to this Plan, businesses owned and controlled by minorities or women will be afforded maximum feasible opportunity to submit bids and/or proposals in response and will not be subjected to discrimination on the basis of race, color, creed, religion, ancestry, national origin, sex, including sexual harassment, sexual orientation, gender identity, disability, age, marital status, or status with regard to public assistance or familial status.

Prospective bidders' attention is called to Minnesota Statues 13.591 Business Data. This section states in part:

Data submitted by a business to a government entity in response to a request for bids as defined in Section 16C.02, Subdivision 11, are private or non-public until the bids are opened. Once the bids are opened, the name of the bidder and the dollar amount specified in the response are read and become public. All other data in a bidder's response to a bid are private or non-public data until completion of the selection process. For the purposes of this section, "completion of the selection process" means that the government entity has completed its evaluation and has ranked the responses.
After a government entity has completed the selection process, all remaining data submitted by all bidders are public with the exception of trade secret data as defined and classified in Section 13.37. A statement by a bidder that submitted data are copyrighted or otherwise protected does not prevent public access to the data contained in the bid.

Bidders are hereby advised that their bid document may become available to the public once a successful bidder has been chosen.

The City of Minneapolis has adopted an Environmental Purchasing Policy (EPP) that is incorporated into all bids. A copy of the policy can be found at this link:
http://wcms/intranet/finance/procurement/policies/WCMS1Q-003476

Prompt Payment: Per Minnesota Statutes 471.425 contractors shall pay all certified small subcontractors for undisputed work completed, within ten (10) days after the City of Minneapolis has paid the contractor for the completed work.

Chapter 471.895 of the Minnesota Statutes prohibits gifts from interested persons to local officials. Local Officials includes any individuals who purchase or advise or recommend on the purchase of goods and/or services.

Conflict of Interest/Code of Ethics: Contractor agrees to be bound by the City's Code of Ethics, Minneapolis Code of Ordinances, Chapter 15. Contractor certifies that to the best of its knowledge, all City employees and officers participating in this Agreement have also complied with that Ordinance. It is agreed by the Parties that any violation of the Code of Ethics constitutes grounds for the City to void this Agreement. All questions relative to this section shall be referred to the City and shall be promptly answered.

All successful bidder(s) will be required to comply fully with the Americans with Disabilities Act of 1990 (ADA).

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Official Publication No. 8313
Published in Finance and Commerce – June 21st and June 28th, 2016

Sealed bids will be received and time stamped by receptionist until **10 AM, Local Time, June 30th, 2016** at which time they will be publicly opened and read aloud. **Do not fax** sealed bids to Purchasing.

Bids must be accompanied by a bid deposit in the amount of **2%** of the total amount bid in the form of a certified check or bidder's corporate surety bond made payable to the Minneapolis Finance Officer.

Successful bidder will be required to enter into a formal contract and provide a Performance Bond and Payment Bond in the full amount of the contract.

A contractor responding to this solicitation document shall submit to the City of Minneapolis a signed statement under oath by an owner or officer verifying compliance with each of the minimum criteria in Minnesota Statutes. Section 16C.285 subdivision 3.

Envelopes must bear the name of the firm submitting the bid and be addressed as follows:

City of Minneapolis Purchasing Department
Offl. Publ. # 8313 – BIDS FOR PROGRAMMABLE LOGIC CONTROLLER
Bids opened 10 AM, Local Time, June 30th, 2016
330 Second Avenue South - Suite 552
Minneapolis, MN 55401

The City of Minneapolis reserves the right to waive informalities in bids, to accept or reject any or all bids or any part of any bid. Bids must be typewritten, or printed in ink, and signed in ink in handwriting.

TWO complete bid form responses, including attachments, are to be returned, one of which **must** be an original.

BIDS CONTAINING ANY ALTERATION OR ERASURE WILL BE REJECTED UNLESS ALTERATION OR ERASURE IS CROSSED OUT AND CORRECTION PRINTED IN INK OR TYPEWRITTEN AND INITIALED IN INK BESIDE CORRECTION BY THE PERSON SIGNING THE BID.

Automatic Bid/RFP Notification:
Visit the Purchasing website at - http://www.minneapolismn.gov/business/business_doing_business_with_city to sign up for e-mail updates and to view Formal Bids, Informal Bids and RFPs

Taxes:
Effective January 1, 2014, State of Minnesota requires vendors to obtain an ST-3 exemption certificate to substantiate a full (State & Local) sales tax exemption on sales to Minnesota cities, counties, and townships. This form can be found on the City of Minneapolis website at http://www.ci.minneapolis.mn.us/finance/procurement.

Instructions to Bidders

IF the Call for Bids, indicates a bid deposit is required, the bid deposit should be in the form of a certified check, cashiers check or bidder's corporate surety bond. If certified check or cashier check is used, it shall be made payable to the Party named in the Call for Bids. Said bid deposit shall be retained by the City of Minneapolis or Board as liquidated damages and not a penalty, in the event the bid is selected by the City of Minneapolis or Board and the bidder fails to execute a contract, therefore, and upon request of the City of Minneapolis or Board, a performance bond and payment bond, as may be required by the City of Minneapolis subsequent to award of contract.

By submitting a bid, bidder agrees that said liquidated damages shall cover only the damages sustained by the City of Minneapolis or Board, from additional administrative costs, expenses or re-advertising and re-bidding and other damages sustained by the City of Minneapolis or Board as a result of failure of successful bidder to execute a written contract, and a performance bond and payment bond when so required, but shall not cover nor preclude the City of Minneapolis or Board from claiming damages on account of delay, price change, loss of other contracts, loss of income, inability of City of Minneapolis or Board to fulfill other contracts, loss of other benefits of this contract, or damages, direct or consequential arising out of breach of contract by the successful bidder.

Whenever separately numbered categories as to materials, equipment or services are set forth in the specifications and in the bid form, unless specifications or bid form is qualified by the statement "ALL OR NONE", bidder may submit a bid upon each, or all, or any selected number of categories, and in such case separate category shall be considered as a separate bid letting procedure, and the City of Minneapolis shall have the right to make separate awards to the lowest and best bidder in any particular category, or to the overall lowest and best bidder where it is found to be in the best interest of the City.

Bidder is responsible to ensure they are in receipt of all addenda. Contact the buyer if questions.

Visit the MN Department of Revenue website, Sales Tax Fact Sheet 176, for tax updates for Local Governments – Cities, Counties and Townships - http://www.revenue.state.mn.us/businesses/sut/factsheets/FS176.pdf

If a lump sum bid for materials and/or equipment includes labor and all incidentals, the bidder is responsible for all applicable sales tax on taxable items required in the performance of the bid and should be included in the total amount bid.

Specification Information

Unless qualified by the provision "NO SUBSTITUTE", the use of the name of a manufacturer brand and/or catalog description in specifying any item does not restrict bidders to that manufacturer, brand or catalog description identification. This is used simply to indicate the character, quality, and/or performance equivalence of the commodity desired, but the commodity on which bids are submitted must be of such character, quality, and/or equivalence that it will serve the purpose for which it is to be used equally well as that specified, and be acceptable to the using department.

In submitting a bid on a commodity other than specified, bidder shall furnish complete data and identification with respect to the commodity he proposes to furnish. Consideration will be given to bids submitted on commodities to the extent that such action is deemed to serve the best interest of the department or boards of the City of Minneapolis.

If a Bidder does not indicate that the commodity he proposes to furnish is other than specified, it will be construed to mean that the bidder proposes to furnish the exact commodity as described.

Bids – City General Requirements

(Revised: March 2015)

The General Conditions are terms and conditions that the City expects all of its Contractors to meet. By submitting a bid, the bidder agrees to be bound by these requirements.

1 City's Rights

The City reserves the right to reject any or all Bids or parts of Bids, to accept part or all of Bids on the basis of considerations other than lowest cost, and to create a project of lesser or greater expense and reimbursement than described in the Call for Bid, or the respondent's reply based on the component prices submitted.

2 Equal Opportunity and Non-Discrimination

The Contractor will comply with applicable provisions of applicable federal, state and city regulations, statutes and ordinances pertaining to the civil rights and non-discrimination in the its application process for and hiring of employees, sub-contractors and suppliers. Among the city ordinances, state statutes and federal statutes to which the Contractor shall be subject to and comply with under the terms of this Contract include, without limitation: Minneapolis Code of Ordinances, Chapter 139; Minnesota Statutes, Section 181.59 and Chapter 363A; 42 U.S.C. Section 2000e, et. seq. (Title VII of the Civil Rights Act of 1964), 29 U.S.C. Sections 621-624 (the Age Discrimination Employment Act), 42 U.S.C. Sections 12101-12213 (Americans with Disabilities Act or ADA), 29 U.S.C. Section 206(d) (the Equal Pay Act), 8 U.S.C. Section 1324 (Immigration Reform and Control Act of 1986) and all regulations and policies and orders promulgated to enforce these laws. The Contractor shall have submitted and had an “affirmative action plan” approved by the City prior to entering into the Contract.

3 Insurance

Insurance secured by the Contractor shall be issued by insurance companies acceptable to the City and admitted in Minnesota. The insurance specified may be in a policy or policies of insurance, primary or excess. Such insurance shall be in force on the date of execution of the Contract and shall remain continuously in force for the duration of the Contract.

Acceptance of the insurance by the City shall not relieve, limit or decrease the liability of the Contractor. Any policy deductibles or retention shall be the responsibility of the Contractor. The Contractor shall control any special or unusual hazards and be responsible for any damages that result from those hazards. The City does not represent that the insurance requirements are sufficient to protect the Contractor's interest or provide adequate coverage. The City of Minneapolis shall be named as an Additional Insured. Evidence of coverage is to be provided on a Certificate of Insurance ACORD Form. A thirty (30) day written notice is required if the policy is canceled, not renewed or materially changed. The Contractor shall require any of its subcontractors, if sub-contracting is allowable under this Contract, to comply with these provisions.

Any Contractor that fails to provide proof of insurance coverage for the Contractor or that fails to provide either coverage for its subcontractors or insurance certificates from any of its subcontractors will be deemed to have submitted a non-responsive bid. The City's award of the Contract will be contingent upon the City's receipt of the required proof of insurance coverage.

The Contractor and its sub-contractors shall secure and maintain the following insurance:

a) **Workers Compensation** insurance that meets the Minnesota statutory obligations with Coverage B- Employers Liability limits of at least $100,000 each accident, $500,000 disease - policy limit and $100,000 disease each employee.
b) **Commercial General Liability** insurance with limits of at least $2,000,000 general aggregate, with coverage for products - completed operations, personal and advertising injury, fire damage and medical expense any one person. The policy shall be on an "occurrence" basis, shall include contractual liability coverage and the City shall be named an "Additional Insured." The coverage amount may be increased if the project amount is expected to exceed $2,000,000 or involves potentially high risk activity.
c) **Commercial Automobile Liability** insurance covering all owned, non-owned and hired automobiles with limits of at least $1,000,000 per accident and the City shall be named an "Additional Insured."
d) **Builders Risk** insurance. Coverage will be written on an "All Risks" (Special Form policy form). The contractor is responsible for all of the deductible in the Builders Risk policy. The property covered shall cover the full insurable value of the improvements, betterments, and include consequential loss insurance. The City of Minneapolis will be named as a loss payee to protect the City's interests with respect to the repair or replacement of any damaged property or other amounts payable under the policy. A builder's risk insurance policy is written specifically for a project and the City of Minneapolis requires a complete copy of the policy. An Installation Floater policy (equipment), may be required as part of the builders risk policy when equipment is being installed by a contractor.

4 Hold Harmless

The Contractor agrees to defend, indemnify and hold harmless the City, its officers and employees, from any liabilities, claims, damages, costs, judgments, and expenses, including reasonable attorney's fees, attributable to the negligent or otherwise wrongful acts or omissions of the Contractor, its employees, its agents, or employees of subcontractors, in the performance of the work or services provided by or through this Contract or by reason of the failure of the Contractor to fully perform, in any respect, any of its obligations under this Contract.

5 Subcontracting

The Contractor shall provide written notice to the City and obtain the City's authorization to sub-contract any work or services to be provided to the City pursuant to this Contract. The Contractor shall not subcontract any services or work under this Contract without prior written approval of the City Department Contract Manager designated herein. As required by Minnesota Statutes, Section 471.425, the Contractor shall pay all subcontractors for subcontractor's undisputed, completed work, within ten (10) days after the Contractor has received payment from the City.

6 Assignment or Transfer of Interest

The Contractor shall not assign any interest in the Contract, and shall not transfer any interest in the same either by assignment or novation without the prior written approval of the City.

7 General Compliance

The Contractor agrees to comply with all applicable Federal, State and local laws and regulations affecting the Contract or governing funds provided under the Contract.

8 Performance Monitoring

The City will monitor the performance of the Contractor against goals and performance standards required herein. Substandard performance as determined by the City will constitute non-compliance with this Contract. If action to correct such substandard performance is not taken by the Contractor within a reasonable period of time to cure such substandard performance, after being notified by the City, Contract termination procedures will be initiated. All work submitted by Contractor shall be subject to the approval and acceptance by the City Department Contract Manager designated herein. The City Department Contract Manager designated herein shall review each portion of the work when certified as complete and submitted by the Contractor and shall inform the Contractor of any apparent deficiencies, defects, or incomplete work, at any stage of the project.

9 Prior Uncured Defaults

Pursuant to City Code of Ordinances, Section 18.115, the City may not contract with persons or entities that have defaulted under a previous contract or agreement with the City and have failed to cure the default.

10 Independent Contractor

Nothing contained in this Contract is intended to, or shall be construed in any manner, as creating or establishing the relationship of employer/employee between the parties. The Contractor shall at all times remain an independent contractor with respect to the work and/or services to be performed under this Contract. Any and all employees of Contractor or other persons engaged in the performance of any work or services required by Contractor under this Contract shall be considered employees or sub-contractors of the Contractor only and not of the City; and any and all claims that might arise, including Worker's Compensation claims under the Worker's Compensation Act of the State of Minnesota or any other state, on behalf of said employees or other persons while so engaged in any of the work or services to be rendered or provided herein, shall be the sole obligation and responsibility of the Contractor.

11 Accounting Standards

The Contractor agrees to maintain the necessary source documentation and enforce sufficient internal controls as dictated by generally accepted accounting practices (GAAP) to properly account for expenses incurred under this Contract.

12 Retention of Records

The Contractor shall retain all records pertinent to expenditures incurred under this Contract in a legible form for a period of six years after the resolution of all audit findings. Records for non-expendable property acquired with funds under this Contract shall be retained for six years after final disposition of such property.

13 Data Practices

The Contractor agrees to comply with the Minnesota Government Data Practices Act (Minnesota Statutes, Chapter 13) and all other applicable state and federal laws relating to data privacy or confidentiality. The Contractor and any of the sub-contractors and suppliers retained by the Contractor to provide work or services under this Contract shall comply with the Act and be subject to penalties for non-compliance as though they were a "government entity."

The Contractor must immediately report to the City any requests from third parties for information relating to this Contract. The City agrees to promptly respond to inquiries from the Contractor concerning data requests. The Contractor agrees to hold the City, its officers, and employees harmless from any claims resulting from the Contractor's unlawful disclosure or use of data protected under state and federal laws.

All Bids shall be treated as non-public information until the Bids are opened for review by the City. At that time, the names of the responders become public data. All other data is private or non-public until the City has completed negotiating the Contract with the selected Contractor. At that time, the Bids and their contents become public data under the provisions of the Minnesota Government Data Practices Act, Minnesota Statutes, Chapter 13 and as such are open for public review.

14 Inspection of Records

Pursuant to Minnesota Statutes, Section 16C.05, all Contractor records with respect to any matters covered by this Contract shall be made available to the City and the State of Minnesota, Office of State Auditor or their designees, upon notice, at any time during normal business hours, as often as the City deems necessary, to audit, examine, and make excerpts or transcripts of all relevant data. Contractor will comply with all State and local audit requirements.

15 Living Wage Ordinance

The Contractor may be required to comply with the "Minneapolis Living Wage and Responsible Public Spending Ordinance" Chapter 38 of the City's Code of Ordinances (the "Ordinance") (http://www.minneapolismn.gov/www/groups/public/@finance/documents/webcontent/convert_255695.pdf). Unless otherwise exempt from the ordinance as provided in Section 38.40 (c), any City contract for services valued at $100,000 or more or any City financial assistance or subsidy valued at $100,000 or more will be subject to the Ordinance's requirement that the Contractor and its sub-contractors pay their employees a "living wage" as defined and provided for in the Ordinance.

16 Applicable Law

The laws of the State of Minnesota shall govern all interpretations of this Contract, and the appropriate venue and jurisdiction for any litigation which may arise hereunder will be in those courts located within the County of Hennepin, State of Minnesota, regardless of the place of business, residence or incorporation of the Contractor.

17 Conflict and Priority

In the event that a conflict is found between provisions in this Contract and the Contractor's Bid, the provisions in the following rank order shall take precedence: 1) Contract including Bid specifications 2) Bid.

18 Travel

If travel by the Contractor is allowable and approved for this Contract, then Contractor travel expenses shall be reimbursed in accordance with the City's *Contractor Travel Reimbursement Conditions*, available from the City.

19 Billboard Advertising

City Code of Ordinance 544.120, prohibits the use of City and City-derived funds to pay for billboard advertising as a part of a City project or undertaking.

20 Conflict of Interest/Code of Ethics

Pursuant to Section 15.250 of the City's Code of Ordinances, both the City and the Contractor are required to comply with the City's Code of Ethics. Chapter 15 of the Code of Ordinances requires City officials and the Contractor to avoid any situation that may give rise to a "conflict of interest." A "conflict of interest" will arise if Contractor represents any other party or other client whose interests are adverse to the interests of the City.

As it applies to the Contractor, the City's Code of Ethics will also apply to the Contractor in its role as an "interested person" since Contractor has a direct financial interest in this Agreement. The City's Code of Ethics prevents "interested persons" from giving certain gifts to employees and elected officials.

21 Termination

The City may cancel this Contract for any reason without cause upon thirty (30) days written notice. Both the City and the contractor may terminate this Contract if either party fails to fulfill its obligations under the Contract in a proper and timely manner, or otherwise violates the terms of this Contract. The non-defaulting party shall have the right to terminate this Contract, if the default has not been cured after ten (10) days written notice or such other reasonable time period to cure the default, has been provided. If termination shall be without cause, the City shall pay Contractor all compensation earned to the date of termination. If the termination shall be for breach of this Contract by Contractor, the City shall pay Contractor all compensation earned prior to the date of termination minus any damages and costs incurred by the City as a result of the breach. If the Contract is canceled or terminated, all finished or unfinished documents, data, studies, surveys, maps, models, photographs, reports or other materials prepared by the Contractor under this Contract shall, at the option of the City, become the property of the City, and the Contractor shall be entitled to receive just and equitable compensation for any satisfactory work completed on such documents or materials prior to the termination.

Notwithstanding the above, the Contractor shall not be relieved of liability to the City for damages sustained by the City as a result of any breach of this Contract by the Contractor. The City may, in such event, withhold payments due to the Contractor for the purpose of set-off until such time as the exact amount of damages due to the City is determined. The rights or remedies provided for herein shall not limit the City, in case of any default by the Contractor, from asserting any other right or remedy allowed by law, equity, or by statute. The Contractor has not waived any rights or defenses in seeking any amounts withheld by the City or any damages due the Contractor.

22 Ownership of Materials

All finished or unfinished documents, data, studies, surveys, maps, models, photographs, reports or other materials resulting from this Contract shall become the property of the City upon final approval of the final report or upon request by the City at any time before then. The City, at its own risk, may use, extend, or enlarge any document produced under this Contract without the consent, permission of, or further compensation to the Contractor.

23 Intellectual Property

Neither the City nor the Contractor anticipate that any intellectual property rights will be created as a result of this Contract. For the purpose of this Contract, "intellectual property" shall include all inventions, improvements, discoveries, processes, computer programs or similar intangible interests that either the City or Contractor develop as a result of the work or project undertaken which is the subject matter of and during the term of the Contract.

Each party acknowledges and agrees that each party is the sole and exclusive owner of all right, title, and interest in and to its services, products, software, source and object code, specifications, designs, techniques, concepts, improvements, discoveries and inventions including all intellectual property rights thereto, including without limitations any modifications, improvements, or derivative works thereof, created prior to, or independently, during the terms of this Contract. This contract does not affect the ownership of each party's pre-existing, intellectual property. Each party further acknowledges that it acquires no rights under this Contract to the other party's pre-existing intellectual property, other than any limited right explicitly granted in this Contract.

24 Equal Benefits Ordinance

Minneapolis Code of Ordinances, Section 18.200, relating to equal benefits for domestic partners, applies to each contractor and subcontractor with 21 or more employees that enters into a "contract", as defined by the ordinance that exceeds $100,000. The categories to which the ordinance applies are personal services; the sale or purchase of supplies, materials, equipment or the rental thereof; and the construction, alteration, repair or maintenance of personal property. The categories to which the ordinance does not apply include real property and development contracts.

Please be aware that if a "contract", as defined by the ordinance, initially does not exceed $100,000, but is later modified so the Contract does exceed $100,000, the ordinance will then apply to the Contract. A complete text of the ordinance is available at:
http://www.minneapolismn.gov/www/groups/public/@finance/documents/webcontent/convert_261694.pdf.
It is the Contractor's and subcontractor's responsibility to review and understand the requirements and applicability of this ordinance.

25 Cardholder Data and Security Standards

Should the Contractor collect revenue on behalf of the City through the acceptance of credit cards offered by cardholders to pay for services offered under the terms of this Contract, then Contractor represents and acknowledges that the Contractor will comply with Payment Card Industry (PCI) regulatory standards including the Data Security Standards (DSS). Contractor represents that it will protect cardholder data. Contractor will be annually certified as a PCI compliant service provider and agrees to provide evidence of said certification to the City upon request. Contractor agrees at reasonable times to provide to the City or to its assigns, the audit rights contained herein for all physical locations, systems or networks that process credit cards on behalf of the City. Contractor

also agrees to provide written notice to the City of any breach of a system owned, operated or maintained by the Contractor that contains cardholder data or information.

26 Small & Underutilized Business Program (SUBP)

See attached current Small & Underutilized Business Program (SUBP) Requirements incorporated herein by reference.

27 City Ownership and Use of Data

The City has adopted an Open Data Policy ("Policy"). The City owns all "Data Sets" as part of the compliance with the Policy. Data Sets means statistical or factual information: (a) contained in structural data sets; and (b) that is regularly created or maintained by or on behalf of the City or a City department which supports or contributes to the delivery of the project underlying this Contract or related programs and functions. The City shall not only retain ownership of all Data Sets, but also all information created through the City's use of software and/or software applications that are licensed by the Contractor (or any subcontractor of the Contractor) to the City

The City shall also retain the right to publish all data, information and Data Sets independently of this Contract regardless of whether the data and information originated from the Contractor or any subcontractor, using whatever means the City deems appropriate. The City shall have the right to access all project data, regardless of which party created the content and for whatever purpose it was created. The Contractor shall provide bulk extracts of data that satisfy the public release criteria for use in and within an open data solution.

28 Responsible Contractor Requirement

The Contractor represents that it is a "responsible contractor." The term "responsible contractor" as used in this document means a contractor as defined in Minnesota Statutes, Section 16C.285 subdivision 3. Any prime contractor or subcontractor that does not meet the minimum criteria in Section 16C.285 subdivision 3 or fails to verify that it meets those criteria is not a responsible contractor and is not eligible to be awarded a construction contract for the scope of work described in the bid documents. A false statement under oath verifying compliance with any of the minimum criteria shall render the prime contractor or subcontractor that makes the false statement ineligible to be awarded a construction contract for the scope of work defined in the bid documents and may result in the termination of a contract awarded to a prime contractor or subcontractor that submits the false statement. A prime contractor shall submit to the City, upon request, copies of the signed verifications of compliance from all subcontractors of any tier pursuant to Minnesota Statutes, Section 16C.285, subdivision 3, clause (7).

Minneapolis
City of Lakes

Department of Civil Rights
350 S. Fifth St. - Room 239
Minneapolis, MN 55415
TEL 612.673.3000
www.minneapolismn.gov

Notice of Civil Rights Rules and Regulations

This notice advises City of Minneapolis contractors of their commitments under Minneapolis Code of Ordinances section 139.50. All contractors must comply with all provisions of Minneapolis Code of Ordinances Title 7 and with all rules and regulations issued by the Minneapolis Department of Civil Rights ("MDCR") director. Contractors will be subject to a pre-award compliance review. Failure to cooperate may result in denial of contract award.

1. **Non-Discrimination**:[1] The contractor will not discriminate against any employee or applicant for employment because of race, color, creed, religion, ancestry, national origin, sex, sexual orientation, gender identity, disability, age (forty (40) to seventy (70)), marital status, or status with regard to public assistance. The contractor will take affirmative action to ensure that all employment practices are free of such discrimination. Such employment practices include but are not limited to the following: Hiring, upgrading, demotion, transfer, recruitment or recruitment advertising, layoff, termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship.
2. **Equal Employment Opportunity/Affirmative Action Employer**: The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that it is an equal opportunity or affirmative action employer.
3. **Affirmative Action Plan**: The contractor must have an Affirmative Action Plan approved by MDCR before it may enter into a contract over $50,000 with the City.
4. **Small and Underutilized Business Program (SUBP)**: When applicable, the contractor must comply with the SUBP program, including, but not limited to, making a good faith effort to meet the Minority-Owned Business Enterprises and Women-Owned Business Enterprises goals established on City construction and development projects.
5. **Employment Goals**:[2] The contractor must make a good faith effort to meet the City's aspirational construction workforce goals of **6%** female participation and **32%** minority participation.
6. **Prevailing Wage**:[3] When applicable, the contractor must comply with prevailing wage laws on City construction and development projects.
7. **HUD Section 3**:[4] When applicable, the contractor must comply with Section 3 of the Housing and Urban Development Act of 1968, as amended. Contractors must incorporate the Section 3 Clause into all subcontracts and to the greatest extent feasible, ensure that employment and other economic activities be directed to low income persons.
8. **Posting Requirement**: The contractor must provide this notice to its trade and labor union or representative of workers and shall post the notice in conspicuous places available to employees and applicants for employment.

[1] Acts of discrimination are defined in the Minneapolis Code of Ordinances, Chapter 139.
[2] See Request for City Council Committee Action, Adopted March 21, 2012; incorporated into section 139.50 as a rule issued by the MDCR director.
[3] See Minneapolis Code of Ordinances section 24.220, CPED Prevailing Wage Policy (adopted by City Council June 8, 2004), and Davis-Bacon and Related Acts; enforcement authority has been delegated to MDCR.
[4] See 24 CFR Section 135.38; enforcement authority has been delegated to MDCR.

Small & Underutilized Business Program (SUBP) Requirements

It is the policy of the City of Minneapolis to provide equal opportunity to all contractors, and to redress the discrimination in the City's marketplace against minority-owned business enterprises (MBEs) and woman-owned business enterprises (WBEs). The SUBP, as detailed in the Minneapolis Code of Ordinances Section 423.60, applies to any non-construction-related equipment, food, material, service or any part or combination thereof over $50,000. Goals may be set on commodity and service contracts based on projected availability of SUBP firms.

There are no specific goals on this contract. However, should the bidder find an opportunity to sub-contract or purchase materials with any businesses on this project, the bidder is required to solicit SUBP firms.

For more information on locating certified businesses, please visit http://mnucp.metc.state.mn.us/ or call the City at 612-673-2112.

For a copy of the latest Prevailing Wage Rates - visit the Federal Website:

http://www.wdol.gov/dba.aspx

Use the Rates for State of Minnesota - Hennepin County
Building
Highway

PREVAILING WAGE CERTIFICATE

SUBMIT WITH ORIGINAL COPY OF YOUR BID

Laborers and Mechanics shall be paid according to the Contracts for Public Works Ordinance, Minneapolis Code of Ordinances, Chapter 24, Section 24.200 through 24.260, as amended, and the minimum wage rates and fringe benefits paid to the various classes shall be as determined by the Secretary of Labor of the United States, for work in the City, subject to and upon compliance with all requirements provided in the Rules of the Office of the Secretary of Labor of the United States. Apprentices may be paid less than the predetermined wage rate for the work performed. Apprentices must participate in a registered apprenticeship program (See 29 CFR, Parts 5 and 29). In addition to the certificates and other evidences of compliance which are required under these specifications and under Minneapolis Code of Ordinances, Section 24.240, it shall be required that the person or company representative submitting a bid for this contract shall certify in writing that both she/he/it and their Subcontractors shall comply with the wage and labor standard provision of Minneapolis Code of Ordinances, Section 24.200 through 24.260 as amended. Failure to comply with this ordinance shall mean the City may, by written notice to the Contractor, terminate the Contractor's right to proceed with the work and the Contractor and his Sureties shall be liable to the City for any excess cost occasioned to the City for the completion of the work.

By submitting this bid, it is understood and agreed that if it is accepted, in whole or in part, by the City of Minneapolis or Board, as designated, that any work done by the Contractor or by the Contractor's agent or Subcontractor under a contract with the City of Minneapolis or Board as designated shall be done in conformity with provisions of Minneapolis Code of Ordinances, Chapter 24, Section 24.200 through 24.260, or, if applicable Park Board Code of Ordinances, Chapter 6, Section PB 6-1 through PB 6-5. Specifically, it is agreed that payment of wages to employees or agents of the Contractor or any Subcontractor shall be no less than the amounts set forth in the current U.S. Department of Labor, General Wage Decision for the State of Minnesota - Hennepin County.

_____
SIGNATURE

_____
Company Name

BY SUBMITTING YOUR BID AND SIGNING THE BID FORM, YOU ARE AGREEING TO ALL OF THE ABOVE

RETURN THIS FORM WITH YOUR BID

Official Publication No. 8313
Bids opened 10 AM, Local Time
June 30th, 2016

BID FORM

My /Our bid to provide all materials, labor, equipment and incidentals for upgrading the Programable Logic Controller for the City of Minneapolis, all in accordance with your specifications. Please include all applicable sales taxes and fees in your bid pricing.

Lump Sum Bid: **$**_____

Numbers must be legible or bid may be rejected.

A single contract will be awarded to the low, responsive, responsible bidder meeting all specifications.

Please return the following documents with your bid:

Bid Form - Prevailing Wage Certificate

F.O.B.: Destination Acknowledge Addenda No. _____ _____ _____

Bidder must supply Federal Tax ID No. or Social Security No. _____
If Social Security Number is provided, this individuals name must be included as Bidder.

Bidder affirms that this bid(s) has been arrived at by the bidder independently and has been submitted without collusion with, and without any agreement, understanding or planned common course of action with, any other bidder of materials, supplies, equipment and services described in the invitation to Bid, designed to limit independent bidding or competition.

TWO complete bid responses including attachments to be returned, one of which must be an **original**.

BIDDER _____
CIRCLE ONE (Corporation - Partnership - Individual)

SIGNED BY _____
(Signature) (Printed Name)

ADDRESS _____

CITY _____ STATE_____ ZIP+4 ZIP CODE_____

BUSINESS PHONE (_____)_____ FAX NUMBER_____

E-MAIL ADDRESS: _____

Public Works
Water Treatment & Distribution
4300 Marshall ST NE
Fridley, MN 55421

PUBLIC WORKS WATER TREATMENT & DISTRIBUTION:

PS6 – PLC Upgrade Project

Narrative

This project consists of upgrading an existing Allen Bradley PLC5 and remote I/O rack(s) with the current version of Allen –Bradley ControlLogix CPU, Chassis, and I/O hardware. The Contractor will modify existing PLC program to conform to new hardware while retaining existing control functionality. The new PLC hardware will connect to the existing Ethernet network via a Cisco EI3000 provided by Owner.

Scope of work:

- PLC layout, design **(SCADA standards)**
- PLC hardware configuration to replace:
  - (qty.6) 1771-IL
  - (qty.2) 1771-IAD
  - (qty.2) 1771-OW16
  - (qty.5) 1771-IBD
  - (qty.1) 1771-SDN
  - (qty.1) 1771-SDN
  - (qty.6) 1771-NR
  - (qty.1) 1771-ODD
  - (qty.2) Chassis 12-slot (CPU & Remote I/O)
- PLC programming
- PLC commissioning and checkout
- Integration of existing power monitors (qty.2)
- Integration of existing VFD's (qty.3)
- Project Management and workflow coordination
- A complete set of As-built Drawings (both printed and digital copies)
- Bill of materials ***(Allen-Bradley materials to be purchased by Owner)***

ALTERNATE(s): None

Notes: All work to start in August and scheduled Tuesdays, Wednesdays, and Thursdays between the hours of 7:30am and 4:00pm. No overtime. All work will follow WTD- Minneapolis Water SCADA standards. Allen-Bradley Materials will be purchased and installed by Owner –WTD. Contractor shall verify all space requirements and limitations. Contractor will field verify all I/O and data point requirements (see layout below).

Brittany M. Pentek
Electrical Engineer, EIT

City of Minneapolis - Public Works
Water Treatment and Distribution
4300 Marshall St. NE.
Minneapolis, MN 55421-2510

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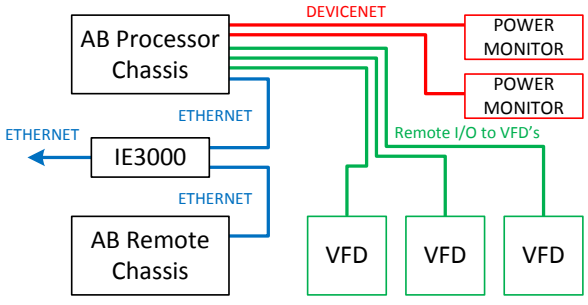
brittany.pentek@minneapolismn.gov



Minneapolis
City of Lakes

SCADA Standard

Version 7.0

Issued 04-15-2016

Minneapolis Public Works
Water Treatment and Distribution Services
Treatment Operations and Maintenance

Minneapolis Water SCADA Standard Revision Table

Version	Reviewed/Updated By	Date	Section(s)	Summary
3.0		8-11-2006	1-11	Full plan update
6.0		10-2009	1-11	Full plan update
6.1	C. Archer	3-23-2010	0	Added revision table
6.1	D. Folen	3-23-2010	2	Added Addendum 1, Table A.1
7.0	SCADA Team	4-15-2016	1-11 (now 1-4)	Full plan update

Table of Contents

Glossary

See 3.1 for abbreviated names of codes and standards.

Alarm	Generally signals an abnormal condition or indicates that a particular stage of processing has been reached.
Bumpless transfer	A protective feature that prevents a sudden change in the control output of a PLC when transitioning between modes, for example from manual mode to auto mode.
Cimplicity	Shorthand designation of Proficy HMI/SCADA – Cimplicity by GE. A software suite used at Minneapolis Water as the basis for the HMI.
Event	A detectable occurrence that may or may not be associated with an alarm. Events represent normal system status messages, and typically do not require an operator response. Examples include an operator action, a change to system configuration, or a system error.
HMI	Human machine interface. A user interface that presents process data to an operator, and through which the operator controls the process. Includes OITs and OWSs.
Hub	Also may be called 'unmanaged switch'. A computer networking device that connects devices together and makes them act as a single network segment. Hubs do not manage any of the traffic that comes through them, and any packet entering any port is broadcast out on all other ports.
Industrial computer	A ruggedized personal computer that is capable of running Windows and commercial computer software such as Cimplicity.
Inputs	Signals or data received by a system.
Interlock	Function that disables or otherwise protects a device or piece of equipment. Typically hardwired interlocks employ physical components (relays, pressure switches) that are hardwired to the controls of the equipment (independent of the PLC program). Software interlocks provide protection solely by inclusion in the programmable control logic.
Local	Control mode independent of the SCADA system where control is performed in the field.
MCC	Motor control center

Minneapolis Water	Shorthand designation for 'the City of Minneapolis Public Works Division of Water Treatment and Distribution Services'.
O&M	Operations and maintenance
OIT	Operator interface terminal. A graphical display unit that is typically mounted on enclosures within harsh environments and that communicate with PLCs. Not a Windows-based personal computer.
Outputs	Signals or data sent from a system.
OWS	Operator workstation. General term for a computer used to monitor and control the plant process. May also be referred to as 'SCADA screen' at Minneapolis Water.
P&ID	Process and Instrumentation Diagram. A diagram that shows the interconnection of process equipment and the instrumentation used to control the process.
PC	Personal computer
PLC	Programmable logic controller. A digital computer used for automation of industrial processes.
Priority	The level of importance associated with an alarm. Minneapolis Water alarms often indicate the level of required response.
Remote-auto	Computer software control mode of the SCADA system where control is automatically performed based on software control logic residing in the PLC.
Remote-manual	Computer software control mode of the SCADA system where all control functions are initiated by the operator from an OWS or OIT.
SCADA client	A computer component on a network that provides a graphical user interface for operators seeking real-time process information and supervisory control, which is requested from the SCADA server over the network.
SCADA system	Supervisory control and data acquisition. The top-end control system for remote monitored sites that is comprised of hosts, multiple workstations, peripherals, and front-end processors. The Minneapolis Water SCADA system includes logging databases, PLCs, instruments/field equipment, and network infrastructure. It also includes HMI functions such monitoring and control,

	trending, and report generation.
Self-healing	A network architecture that can withstand a failure in its transmission paths.
Server	A computer component on a network that responds to requests for information or services from other computers on the network. A SCADA server establishes and maintains the database of real and calculated field signals and control states, and controls central resources such as printers. SCADA clients request information stored in the SCADA server for monitoring and control by operators at OITs or OWSs.
Switch	A computer networking device that connects network segments. A managed Ethernet switch offers more control than an unmanaged switch as it provides control capabilities that can increase network security and performance.
Tagname	Also may be called 'variable', or 'point'. A unique identifier used within the PLC and server as the name and storage location of a single analog or discrete signal, or calculated variable or state.
TCP/IP	Transmission Control Protocol/Internet Protocol. A standard Ethernet protocol layer that allows multi-vendor systems to communicate on a common network. TCP/IP is the existing standard for transmitting data on computer networks. TCP/IP supports several vendor application layers, such as Modbus/IP or Ethernet/IP.
UPS	Uninterruptible power supply. A continuous power supply or a battery backup that maintains a continuous supply of electric power to connected equipment by supplying power from a separate source when utility power is not available.
Vendor system	A system or piece of process equipment provided by a single supplier or vendor. It is typically equipped with a PLC and OIT, which are programmed by the vendor due to the vendor system's customized nature.
VFD	Variable frequency drive
Watchdog timer	Timing device or mechanism that triggers a system reset or response due to a fault condition.

1.0 Introduction

1.1 Overview

The Minneapolis Water SCADA Standard (hereafter, 'the Standard') has been prepared for use by designer engineers, contractors, hardware fabricators, installers, and system integrators of instrumentation and control systems at the City of Minneapolis Public Works, Division of Water Treatment and Distribution Services (hereafter, 'Minneapolis Water').

In this document:

- 'Consultant' refers to personnel involved in the design process, such as design engineers.
- 'System integrator' refers to software integrators, hardware fabricator, and programmers. The roles of software integrator and hardware fabricator may be filled by the same or by separate personnel.
- 'Vendor' refers to system suppliers and equipment manufacturers.
- 'Contractor' refers to general contractors and their subcontractors doing physical installation.

1.2 Purpose and Scope

The purpose of this Standard is to define the minimum requirements for the design and implementation of all SCADA projects at Minneapolis Water. These requirements are intended to promote consistency, efficiency, and usability across all areas of the SCADA system.

The Standard provides the following information:

- Detailed guidelines for designing and implementing SCADA projects at Minneapolis Water.
- Required parts specifications and lists of example manufacturers and models.
- Technical information to support the use of standard project methodologies, nomenclature, and control philosophies for the SCADA system.
- Acceptable implementation practices and standards that are in accordance with Minneapolis Water preferred practices.

This Standard does not cover the security network (such as access control or camera systems).

The standards set out in this document must be applied to all projects related to the SCADA system or having a SCADA component.

This Standard is a part of the contractual requirements for all firms and companies working on SCADA-related projects at Minneapolis Water through design, construction, and programming.

Minneapolis Water shall be involved in the entire design and installation process of SCADA and communications technologies to guide and confirm compatibility and consistency with the existing systems.

Design professionals shall clearly state any Minneapolis Water-approved exceptions to the Standard within the bid documents. It shall be the responsibility of the bidder to value the impact of these standards and any exceptions within the bid.

All designs for construction projects that affect the SCADA system shall include this Standard as an appendix of the contract. The consultant's SCADA-related specifications shall conform to the requirements of the Standard. In addition, specific references to the Standard shall be embedded in the consultant's SCADA-related specifications developed for the project, identifying corresponding requirements by section citation.

1.3 Usage Guidelines

When new automation is incorporated into Minneapolis Water facilities, or existing automation is upgraded, the work shall be performed in accordance with the standards set out in this document. This is to ensure that work done is consistent with overall goals of Minneapolis Water.

Existing systems will not typically be upgraded only to comply with this Standard. However, this Standard provides methods by which new systems should be merged with existing systems.

Use of the SCADA Standard is required. The Minneapolis Water SCADA Standard is to be continuously and consistently applied to all projects interfacing with SCADA. Minneapolis Water will enforce these standards during the design, implementation, and ongoing support of all SCADA projects. It shall be the responsibility of the consultant, contractor, and system integrator to apply these standards. If a proposed design incorporates an exception to this Standard, the designer must submit a written request to Minneapolis Water SCADA team early in the design process. The request shall include reasons for the proposed exception, considering long-term maintenance and support. The right to waive or amend any portion of this Standard shall be held by the Minneapolis Water SCADA team alone.

1.4 Revision Control

The periodic review frequency of this Standard is every three years and shall be conducted by a cross-disciplinary team of Minneapolis Water personnel. Between periodic reviews, the Standard shall also be updated as necessary to reflect changes to technologies at Minneapolis Water. Proposed changes may be submitted to the committee for review; accepted changes shall be incorporated into the Standard. All revisions shall be added to the Revision Table at the front of this document. The latest revision date for each section shall be noted in each section's header.

2.0 Control System Design Standards

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2.1 Core Expectations

Minneapolis Water seeks to

- Move towards a more integrated, systematic treatment process control system using SCADA.
- Maintain a technology infrastructure to industry best practices, while securing critical systems to industry-level standards.

To support these objectives, Minneapolis Water has established the following expectations for the process control system.

- A reliable, accurate, and flexible system that is designed around the needs of Minneapolis Water operators, technicians, engineers, and IT personnel.
- Standardized hardware and software to reduce spare parts inventory and software licenses.
- System documentation and PLC programming that is well-organized, fully-documented, and up-to-date, to ease system maintenance and troubleshooting.
- Automation, interface layout, and alarming that maximize operator productivity.
- Clean, intuitive trends with proper labeling of axes and series units.

2.2 Drawing Conventions

All final drawings shall adhere to the Minneapolis Water Drawing Standards, which defines general requirements for drawing sheet and title block, CAD standards, sheet numbers, cross-references, cross-section labeling, detail labeling, and graphic scales. Obtain the Drawing Standards from Minneapolis Water during the design phase.

See **Appendix A** for example location/electrical layout.

See **Appendix B** for example P&ID.

See **Appendix C** for example schematics.

See **3.13 Schematic Conventions** for PLC schematic requirements.

2.3 Tagnaming Conventions

2.3.1 APPLICATION

Systems, process equipment, and instruments shall each be uniquely identified using the following tagnaming conventions. Tagnames shall be developed during the design phase and consistently applied to points on all drawings, PLC program descriptions and symbols, and in the Cimplicity (SCADA/HMI) database.

Some existing systems use old tagnaming conventions, which followed the format SS_NN_TT_LLLL_DD_II. The fourth tag (LLLL) does not adhere to current loop number abbreviations. New projects and expansions to existing systems may require blending current conventions and old conventions. New design shall adhere to current conventions. Bid specifications shall identify if existing tags for non-modified equipment shall be updated.

2.3.2 TAGNAME STRUCTURE

Tagnames shall be structured to according to the pattern in **Figure 2-1**, which is designed to uniquely identify and define each device by progressing from general location to specific function.

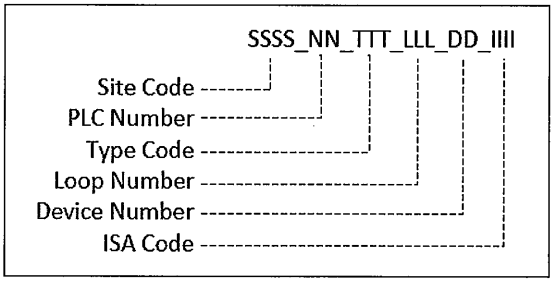


Figure 2-1 Tagname Structure

2.3.3 TAG DESCRIPTIONS

Site Code	Three to four alpha/numeric characters that identify a specific facility or location at Minneapolis Water. Obtain site codes from Minneapolis Water.
PLC Number	Two numeric characters that identify which PLC controls or monitors the tagged device. Numbers shall be assigned incrementally within a site, starting at 01. Remote I/O panels may be numbered in this same sequence (e.g. IO_22), but all tagnames shall refer to the PLC number.
Type Code	One to four alpha characters that identify the specific equipment or instrument monitored or controlled. Instrument codes follow standard ISA practices. See **Table 2-2** and **Table 2-3** for type codes used at Minneapolis Water.

Note: It is not the intent of this Standard to prevent the development of new codes for

new equipment or instruments. New codes shall be incorporated into this Standard.

Loop Number — Four numeric characters that identify a specific point in the process. The first two digits are associated with a process point. The second two digits are assigned incrementally within a process. See **Table 2-4** for loop numbers used at Minneapolis Water.

Device Number — Two numeric characters that identify common devices within a specific control loop. Numbers shall be incrementally within each loop number.

ISA Code — Two to four alpha characters that identify the information that the device is intended to convey to the SCADA system. See **Table 2-5** for ISA codes used at Minneapolis Water.

2.3.4 RULES FOR TAGNAME ASSIGNMENT

- Whole tagnames shall be unique in the Minneapolis Water network.
- Underscore characters shall separate tags.
- Each tagname shall not exceed 31 characters, including underscores.
- Virtual tagnames may vary from these conventions, but shall use as much of the related tag as possible.
- Use of virtual tagnames shall require pre-approval by Minneapolis Water.

Table 2-1 gives examples of tagnames used in past installations.

Table 2-1 Example Tagnames

Description	Tagname
CHMP, Butterfly Valve 6 on Ultrafiltration Unit 2, PLC 1	CHMP_01_VBF_3102_06
CHMP, Pressure Transmitter 2 on Ultrafiltration Unit 9, PLC 3	CHMP_03_PIT_3109_02
CHMP, Pressure Transmitter 2 on Ultrafiltration Unit 9, PLC 3 (pressure data)	CHMP_03_PIT_3109_02_PI
DWP, Current, phase B, Feed Pump 5, PLC 3	DWP_03_PMP_7405_02_II
DWP, Flow Meter 1 on Filter Press Feed Pump 5, PLC 3 (totalized flow data)	DWP_03_FIT_7405_01_FQ
DWP, Power, Feed Pump 5, PLC 3	DWP_03_PMP_7405_01_JI

2.3.5 STANDARDIZED TAGS USED AT MINNEAPOLIS WATER

Table 2-2 Equipment Type Codes (TTT)

TTT	Equipment	TTT	Equipment
AD	Air Dryer	MAU	Make-Up Air Unit
AF	Air Filter	MIX	Mixer, General
AFC	Aftercooler	MX	Mixing Chamber
AHU	Air Handling Unit	MXS	Mixer, Static
ALM	Alarm	PMP	Pump
AR	Air Receiver	RSV	Reservoir
ATS	Automatic Transfer Switch	SAB	Strainer, Automatic Backwash
B	Bin	SC	Scale
BFP	Backflow Preventer	SCR	Screen
BLR	Blower	SC	Scrubber
BVR	Bin Vibrator	SG	Sight Glass
CAL	Calibration Column	SIX	Softener, Ion Exchange
CF	Chemical Feeder, General	SLK	Slaker
CGS	Chlorine Gas Scrubber	STR	Strainer, Manual Clean
CMP	Compressor	SWG	Switchgear
CV	Conveyor or Auger	T	Tank
CYL	Gas Cylinder, Container	UFM	Membrane, Ultrafiltration
DIF	Diffuser	UPS	Uninterruptible Power Supply
DMP	Pulsation Dampener	VAR	Valve, Air Release
DPS	Diaphragm Seal	VBF	Valve, Butterfly
EEW	Emergency Eye Wash	VBL	Valve, Ball
ES	Emergency Shower	VCK	Valve, Check
ESE	Emergency Shower and Eye Wash	VCR	Valve, Air / Vac Combination
EXC	Expansion Chamber	VD	Valve, Diaphragm
FAN	Fan, Supply or Exhaust	VG	Valve, Gate
FD	Floor Drain	VGB	Valve, Globe
FDR	Feeder, Dry Chemical	VL	Valve, General
FLT	Filter	VNL	Valve, Needle
FM	Flow Meter, Magnetic	VP	Vacuum Prime
FS	Float Switch	VPG	Valve, Plug
FSW	Filter Surface Wash	VPR	Valve, Pressure Regulating
FV	Flow Meter, Venturi	VPR	Valve, Pressure Relief
GEN	Generator	VRV	Valve, Non-Flood Rotary

GFD	Gas Feeder	VS	Valve, Solenoid
GR	Grit Conveyor	VSA	Valve, Surge Anticipating
GSL	Gate, Sluice	VSR	Valve, Safety Relief
GWH	Gas Water Heater	VTW	Valve, Three Way
HEX	Heat Exchanger	VVR	Valve, Vacuum Release
HPR	Hopper	WR	Weir, General
HTR	Heater, Process Water	WRV	Weir, V-Notch
HVR	Hopper Vibrator	XFR	Transformer
HWB	Boiler, Heating Water		

Table 2-3 Instrument Type Codes (TTT)

TTT	Instrument	TTT	Instrument
AIT	Analysis Indicating Transmitter	LT	Level Transmitter
ART	Analysis Recording Transmitter	MB	Motor Stop
ASH	Analysis Switch High	MD	Motor Start
ASL	Analysis Switch Low	MLN	Motor Light Run
AT	Analysis Transmitter	MN	Motor Run
EIT	Voltage Indicating Transmitter	MNH	Motor Run High (Fast or Forward)
ERT	Voltage Recording Transmitter	MNL	Motor Run Low (Slow or Reverse)
FCV	Flow Control Valve	PCV	Pressure Control Valve
FIT	Flow Indicating Transmitter	PIT	Pressure Indicating Transmitter
FQIR	Flow Totalizing Indicating Recorder	PRT	Pressure Recording Transmitter
FRT	Flow Recording Transmitter	PSH	Pressure Switch High
FSH	Flow Switch High	PSL	Pressure Switch Low
FSL	Flow Switch Low	PT	Pressure Transmitter
FT	Flow Transmitter	SIT	Speed Indicating Transmitter
FY	Flow Controller	SRT	Speed Recording Transmitter
HMS	Hand Momentary Switch (or Pushbutton)	SSH	Speed Switch High
HS	Hand Switch (or Pushbutton)	SSL	Speed Switch Low
IIT	Current Indicating Transmitter	TIT	Temperature Indicating Transmitter
IRT	Current Recording Transmitter	TRT	Temperature Recording Transmitter
JIT	Power Indicating Transmitter	TSH	Temperature Switch High
JRT	Power Recording Transmitter	TSL	Temperature Switch Low
JSL	Power Switch Low (Power Failure Relay)	VIT	Vibration Indicating Transmitter
KI	Time Indicator (Clock)	VRT	Vibration Recording Transmitter

KIQ	Total Runtime Meter	VSH	Vibration Switch High
LAHL	Level Alarm High, Low	VSL	Vibration Switch Low
LAL	Level Alarm Low	WIT	Weight Indicating Transmitter
LALL	Level Alarm Low-Low	WRT	Weight Recording Transmitter
LCV	Level Control Valve	WSH	Weight Switch High
LIC	Level Indicating Controller	WSL	Weight Switch Low
LIT	Level Indicating Transmitter	YN	Computer Mode
LRT	Level Recording Transmitter	ZIT	Position Indicating Transmitter
LSH	Level Switch High	ZRT	Position Recording Transmitter
LSHH	Level Switch High-High	ZSH	Position Switch High (Open)
LSL	Level Switch Low	ZSL	Position Switch Low (Closed)

Table 2-4 Loop Numbers for Systems (first 2 digits)

LLxx	Process Point	LLxx	Process Point
10	Raw Water Screening	52	—
11	Raw Water Pumping	53	—
12	Raw Water Storage / Settling	54	—
13	Softening Pretreatment	55	—
14	Softening	56	Carbon Dioxide
15	Softening Cone Underflow	57	Citric Acid
16	Softened Water Pumping	58	Sulfuric Acid
17	Softened Water Storage	59	Soda Ash
18	Mixing / Coagulation	60	Lime
19	Flocculation	61	Alum
20	To Open Basin	62	Ferric Chloride
21	Clarification	63	Powdered Activated Carbon
22	Ozone	64	Potassium Permanganate
23	Gravity Filters	65	—
24	Activated Carbon Contactors	66	—
25	Ultraviolet	67	Gravity Thickener
26	— *	68	Thickener Underflow
27	Finished Water Pumping	69	Thickener Overflow
28	Finished Water Storage	70	Spent Backwash Water Recovery
29	Filter Influent	71	Process Drain Recovery
2901	Filter Influent East	72	Effluent to Surface Water (River)
2902	Filter Influent West	73	—

30	Ultrafiltration Feed	74	Filter Press Feed
31	Ultrafiltration Filters	75	Filter Press
32	Combined Filter Effluent (CFE)	76	Centrifuge (Including Inlet & Cake)
3201	Combined Filter Effluent East	77	Pressate / Centrate
3202	Combined Filter Effluent West	78	—
33	Backwash Supply	79	—
34	Chemically Enhanced Backwash	80	Compressed Air (UF Integrity)
35	Neutralization	81	Compressed Air (Operations)
36	Lagoons	82	Service Water / Flushing
37	Air Scrub / Air Wash	83	Plant Drainage to Sewer
38	Plant Effluent (PE)	84	Residuals Discharge
3801	Plant Effluent East	85	Engine Generator
3802	Plant Effluent West	86	Security
39	Coag / Settling Underflow	87	Fire Protection
40	Chlorine	88	Lifting Systems
41	Ammonia	89	Safety Systems
42	Fluoride	90	Electrical Power - 2,300 VAC and Higher
43	Polyphosphate	91	Lighting & Receptacles
44	Sodium Hypochlorite	92	Gas Service
45	Hydrochloric Acid	93	HVAC
46	Sodium Bisulfite	94	Dehumidification
47	Sodium Hydroxide	95	Fuel Oil
48	Clean In Place	96	Electrical Power - 480 VAC and Less
49	—	97	Uninterruptible Power Supply
50	Chemical Interceptor Tank	98	Alternative Energy
51	—	99	—

* M dash indicates open numbers

Table 2-5 ISA Codes (III)

IIII	Information	IIII	Information
AH	Analytical Level High Alarm	MDA	Motor Fail To Start Alarm
AI	Analytical Indication (e.g. pH)	MF	Motor Fail Indication
AM	Manual / Automatic	MN	Motor Run Indication
CF	Common Fault Alarm (Any of Several Faults To Inhibit Operation)	MNA	Motor / Pump Run Longer than Expected
EI	Volt Indication	MX	Ready For Maintenance Indication
EI	Real-Time KVAR Demand Indication	PB	Test Point (On Screen or Virtual)
EIQ	KVAR Hours Totalizer	PC	Pressure Control / Pressure Setpoint
EIX	KVAR Hours	PD	Pressure Differential
FAL	Low Flow Alarm	PH	Pressure High
FC	Flow Control / Flow Setpoint	PI	Pressure Indication
FG	Flowrate, mgd	PI	Pressure Indication – Discharge
FI	Flow Indication, gpm	PI	Pressure Indication – Suction
FK	Flowrate, Kilogallons/Hour	PL	Pressure Low
FQ	Flow Totalizer, million gallons	RE	Reset Faults Command / Reset Alarm Command
FQKG	Flow Totalized, Kilogallons	SC	Speed Control / Setpoint Control
FQMG	Flow Totalizer, mgd	SI	Speed Indication
FSH	Flow High or Pump Primed Indication	TAH	Temperature High Alarm (Warning Level)
GFI	Ground Fault Indication	TAHH	Temperature High Shutdown Alarm
HR	Ammonia 35 ppm	TC	Temperature Control / Temp Setpoint
II	Current / Amps Indication	TD	Temperature Differential
JA	Loss Of Power Alarm	TGR	Equipment Tagged Out of Service - Red
JB	UPS Battery Alarm	TGY	Equipment Tagged - Yellow
JF	Power Fail/Power "On" Indication	TH	Temperature High
JI	Power kW Indication	TI	Temperature Indication
JID	Kilowatt Demand Indication	TL	Temperature Low
JIQ	KW Hours Totalizer	TT	Today's Total (Current 24 Hours)
JIX	KW Hours	VC	Vibration Control / Vibration Setpoint
JL	Power Low	VHA	Vibration High Alarm (Warning Level)
JN	Power On / Power OK	VHS	Vibration High Shutdown Alarm
JS	UPS On Battery Power	VI	Vibration Indication
JX	Power Lockout	WI	Weight Indication
JY	Real Time Power Factor Indication	XA	Fire / Smoke Alarm

KD	PLC Watchdog Time, Seconds	XAF	Fire / Smoke Trouble
KQ	Accumulated Runtime Totalizer	XS	Door Alarm / Unauthorized Entry Alarm
KX	PLC Communication Watchdog Bit	YA	Ready
LA	Level Alarm	YL	Standby
LAH	Level High Alarm	YN	PLC Mode / Remote Control Mode
LAL	Level Low Alarm	YS	Blower Surge Alarm
LC	Level (or Start/Stop Level) Setpoint	YT	Yesterday's Total (Past 24 Hours)
LD	Level Differential	ZB	Close Command
LE or LEAD	Selected As Lead Indication and Control	ZC	Position Control/Position Setpoint
LI	Level Indication	ZD	Open Command
LR	Ammonia 25 ppm	ZF	Failed to Open or Close
MA	Motor Fail / Cutout Alarm	ZH	Full Open Indication
MB	Stop Command	ZI	Position Indication
MBA	Motor Fail To Stop Alarm	ZL	Full Closed Indication
MD	Start Command	ZZ	Stop Movement / Hold Position Command

2.4 Control Concepts

The primary function of the SCADA system is to provide a cohesive real-time interface that allows operators to interact with process operations. The secondary function is to automate time-consuming and routine tasks.

The following control concepts shall guide the design process.

2.4.1 OPERATIONAL MODES AND GENERAL REQUIREMENTS

- All devices shall be equipped to provide positive feedback confirmation to the SCADA system.
- Hardwired safety interlocks, not the SCADA system, shall be used to prevent equipment from running under undesirable conditions.
- All devices shall have local control.
- OIT control shall require that the local PLC be operating.
- OWS control shall mimic OIT control.
- Equipment shall have start/stop pushbuttons (open/close for valves). Equipment shall have a separate local/remote selector switch.

- The location of selector switches and pushbuttons shall be per equipment to locate in the field, MCC, VFD, or multiple locations per control needs.
- Equipment shall have hardwired emergency stop hand switches or pull cords. The emergency stop shall be installed near the equipment or devices.
- OITs shall be provided for PLC control panels as specified in bid specifications. The use of mechanical switches and lamps shall be minimized.
- Control equations shall consider minimizing shock to Minneapolis Water systems when changing equipment from manual mode to auto mode, and from auto mode to manual mode.
- A facility UPS shall power each SCADA control panel to maintain PLC, OIT, and network operation during plant power outages. The consultant shall evaluate the additional load requirements on the existing facility UPS, inform Minneapolis Water of backup capacity and duration (including new loads), and advise Minneapolis Water if additional UPS power is needed.

2.4.2 INSTRUMENTATION

- Data from all monitored instruments shall be accessible over the SCADA network.
- Transmitters and transducers shall be mounted as near to the measurement point as practical.
- Instrumentation shall be readily and safely accessible from grade or permanent platforms to facilitate ease of maintenance.
- Communications from analog instrumentation shall be provided as 4-20 mA signals.

2.4.3 GATES AND VALVES

- Full open/full close type valves that are remotely controlled shall have limit switches for both the fully-opened and fully-closed positions.
- Modulating valves and gates that are remotely controlled shall have limit switches for both the fully opened and fully closed positions. Positive positional feedback (% opened) shall also be provided for remote monitoring. Valve position control shall not be solely used to indicate a calculated valve position. Modulating valve positions shall be provided by a feedback loop.
- Limit switch monitoring for manually controlled valves (field control only) shall be handled on a case-by-case basis. If monitoring is required, only one limit switch may be required to monitor the valve in its normal operating position. Limit switch monitoring is required if any of the following apply.
    - Improper position may result in health or safety risk.
    - Improper position may lead to damage to other equipment.

  - Improper position may lead to an operation being out of compliance with operating regulations.
  - Improper position may result in an environmental hazard.

- Limit switches and position sensing transmitters shall be supplied by either the manufacturer of the gate/valve as an integral part of the gate/valve assembly, or by the manufacturer of the control actuator as an integral part of the actuator assembly.

2.4.4 PUMPS AND MOTORS

- Motors shall be constant, fixed speed, variable speed, or synchronous.
- All adjustable speed drives shall be VFDs. No multi-speed drives (dual speed motors) shall be incorporated into future designs.
- All motors that are remotely controlled require monitoring of the status of the motor contactor.
- Starters and circuit breakers shall be NEMA rated if used in an across the line application.
- Power monitors shall be included on main switchgears and motors 100 hp and greater. This function may be provided by a VFD or soft starter and must communicate with PLC via Ethernet.
- Physical run time meters shall be included on motor starters and VFDs 5 hp and greater, unless run time is monitored by a PLC.
- VFDs shall be selected to avoid harmonic distortions across Minneapolis Water power system. Harmonics shall be mitigated at the contractors' expense.

2.4.5 PROGRAMMABLE LOGIC CONTROLLERS

- All PLCs shall be integrated into the SCADA system via Ethernet for remote monitoring and control.
- All calculations of totals shall be performed at the lowest possible level and the value shall be carried up through higher levels for purposes of reporting.
- All automated control strategies shall be executed by the PLC. Automated control logic or software interlocks shall not be performed at the OWS.
- Control devices shall be connected in a way that results in a fail-safe mode in the event of a PLC failure.
- Unless specifically approved by Minneapolis Water, control and timer relays shall only be used where required by regulations to provide hardwired critical safety and process interlocks.
- All I/O shall be direct connected to the PLC from the IFM card, except where interposing relays are necessary for hardwiring safety circuits.

- To provide redundancy, distribute the I/O to match physical redundancy. A single I/O card failure should NOT impede operation of the redundant part of the system.
- Communication from PLC to PLC shall use the SCADA network.
- Communication from PLC to remote I/O in the same panel shall use either ControlNet or Ethernet.
- Communication from PLC to remote I/O in a different panel shall use the SCADA network.

2.4.6 VENDOR SYSTEMS

General vendor system philosophies include:

- All vendor-provided, pre-packaged PLC systems shall be designed to integrate into the SCADA system via Ethernet. The PLC shall support messaging via Ethernet/IP protocol. If PLCs listed in **Table 3-6** are not used, then the vendor shall furnish protocol converters as required to permit direct communication between the vendor PLC and the plant processors over Ethernet. Troubleshooting and resolving Ethernet communication problems between the plant PLC systems and the vendor PLC shall be the vendor's responsibility.
- The consultant shall determine SCADA monitoring requirements and receive approval from Minneapolis Water prior to purchase of vendor equipment.
- A complete list of available outputs and alarms for the vendor system shall be reviewed with Minneapolis Water to identify the information to be conveyed to and displayed in SCADA.
- Unless the system is fully automated locally, remote-manual control via SCADA shall be provided for the vendor system.
- The consultant shall coordinate with Minneapolis Water to determine the desired level of remote control—either full or limited—with the vendor system.
    - Full control: The OWS has all vendor system control functions, including setpoints, available, typically identical to the OIT.
    - Limited control: The OWS has a sub-set of functions available.
- The vendor and the system integrator shall provide required I/O to Minneapolis Water per the design.

2.5 Design Collaboration, Submittals, and Review

Design collaboration to review I/O, HMI displays, and control strategies is expected from consultants, contractors, and system integrators.

2.6 Process Narratives

A Process narrative is required by Minneapolis Water for integration of new or revised processes and for new facilities.

2.6.1 INTRODUCTION

Process narratives are living documents that explain the operation expected of equipment by the control system and the limits that trigger the operation. Process narratives are critical to the proper startup, operation, and troubleshooting of processes. Process narratives document the detailed decisions made regarding the control of each device and process connected to SCADA.

2.6.2 DEVELOPMENT AND REVIEW PROCESS

1. For rehabilitation or expansion projects, the existing process narrative may need to be updated for content and conformity to these standards so that it may serve as the 'baseline' document for subsequent modification. Minneapolis Water, the consultant, and the system integrator shall review the existing narrative for accuracy and conformity. For projects implementing new processes, the consultant shall obtain an example narrative from Minneapolis Water as a reference for document format and content.
2. The consultant shall develop a draft process narrative as part of the project specifications. The process narrative and control methods shall be defined to allow for bidding of system integration services.
3. Prior to PLC programming, the system integrator shall modify the process narrative draft and submit the updated draft to Minneapolis Water for review, discussion, and edits.
4. Prior to factory and site acceptance tests, the system integrator shall submit an updated process narrative draft to Minneapolis Water. Any edits made during testing shall be included in the final process narrative.
5. At the end of the project, the consultant shall submit the process narrative as part of the record documents turned over to Minneapolis Water.
6. After project completion, the finalized process narrative shall be signed and dated electronically by the Minneapolis Water area supervisor.
7. The process narrative shall be published electronically and made available to staff.
8. Revision history and parties involved shall be documented.

2.6.3 CONTENT

A typical process narrative shall include the following.

- Background and history of the facility or process
- General function of the facility and an overview of major equipment
- Reference documents
- Critical process parameters and operational needs
- Control strategy for each unit process that includes
    - Description of the process
    - Equipment
    - Local control capabilities
    - Remote control capabilities
        - Operator selections / supervisor selections
        - Control modes
        - Setpoint functionality
        - Transitions
        - Special calculations
    - Alarms
        - Setpoints
        - speed calculations
        - Messages to operator
        - Priority of each alarm
    - Events
        - Setpoints
        - Operator selections / supervisor selections
- SCADA summary tables that list
    - Variables displayed as viewable information to the operator
    - Controllable setpoints
    - Digital on/off control functions available to the operator

3.0 SCADA Construction Standards

3.1 Codes and Standards

The following codes and standards shall be applied.

- International Society of Automation (ISA)
  - ISA S5.1 Instrumentation Symbols and Identification
  - ISA S5.2 Binary Logic Diagrams for Process Operations
  - ISA S5.3 Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Systems
  - ISA S5.4 Instrument Loop Diagrams
  - ISA S20 Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves
  - ISA RP60.3 Human Engineering for Control Centers
  - ISA RP60.6 Nameplates, Labels, and Tags for Control Centers
- National Electrical Manufacturers Association (NEMA)
- National Fire Protection Association (NFPA)
  - NFPA 101 Life Safety Code
  - NFPA 70 National Electrical Code (NEC)
  - NFPA 70E Standard for Electrical Safety in the Workplace
- Underwriters Laboratories (UL)
  - UL 508 (and all subsections) Standard for Industrial Control Equipment
- ASTM International (ASTM)
  - ASTM A269 Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
- Network equipment shall follow UL, NEMA, NFPA, and CompTIA/EIA codes and standards.

3.2 Environmental Conditions and Building/Room Design

Review all areas to determine the NEMA enclosure requirements. In environments that have the potential to become wet from to cleaning, maintenance, or repair activities, designate NEMA 4 or 4X. In areas near chemicals, designate NEMA 4X and require fiberglass or PVC components.

Each project shall include provisions to protect network equipment and servers from damaging environmental conditions such as dust, heat, and humidity. Climate-controlled rooms with open racks are preferred; however environmentally-controlled cabinets may also be used. All racks shall accommodate standard components. Preferred rack width is 19 inches. Consider maintenance access around all racks and cabinets in the design and layout. Remote network devices shall be in cabinets suitable for the specific environment.

3.3 Process Equipment and Instruments

3.3.1 DESIGN CRITERIA

- For motors between 0.5 hp to 500 hp, use 480 VAC three-phase. For motors smaller than 0.5 hp, use 120 VAC single-phase. For motors larger than 500 hp, use of 4160 VAC shall be considered. Confirm final motor design criteria with Minneapolis Water.
- Use 24 VDC for control wiring (discrete I/O for PLC) wherever possible to reduce interference in analog signal lines.
- Determine how each device will respond in both short-term and long-term power failures. The 120 VAC power shall be backed up when appropriate.
- If a device requires a 120 VAC control signal, an interposing relay shall be included to convert 24 VDC PLC signal to 120 VAC.
- Limit switches shall be 24 VDC wetted.
- Position and position feedback signals (4 to 20 mA) shall use shielded cable, and may be placed in conduits with 24 VDC controls, but not with 120 VAC.

3.3.2 INSTRUMENT TAGS

A permanent tag shall be attached to each instrument.

- Material: black engravable acrylic with white substrate, or white engravable acrylic with black substrate, 1/8" thick
- Lettering: 1/4" W
- Holes: 1 or 2 as needed, 3/16" diameter, 1/4" from side and centered.
- Interior surface mount adhesive: 3M double-sided adhesive transfer tape
- Exterior mount adhesive: 3M instant adhesive gel
- Hanging: All hanging tags shall be secured and supported by nylon tie-wraps, sized as required

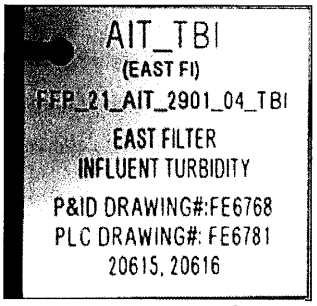


Figure 3-1 Example Instrument Tag

3.3.3 INSTRUMENT SPECS AND EXAMPLE MODELS

Table 3-1 lists required instrument specs and example models used in previous installations. This product identification is not intended to limit competition, but rather to minimize the number of spare parts. This is not a representation of what devices or system will work in any future project. Specification writers may allow a bidder to provide a smaller percentage of spare parts if the exact matching parts will be installed.

Instruments are for water service unless noted.

EPDM-P, Viton (FKM), or Teflon (PTFE, TFE) shall be used for elastomer parts of instrumentation in contact with process water or plumbing water. Neoprene and Buna-N are not acceptable for water contact due to the use of chloramine. The manufacturer shall document the best elastomer for compressed air and specific chemicals.

Table 3-1 Instrument Specs and Example Models

	Application	Instrument	Example Models
Flow Measurement	Magnetic flowmeter system	Head: Pulsed DC, stainless steel metering tube, ANSI 150# flanges, 316SS electrodes Transmitter: NEMA4X wall or pipe mount, digital display, 4-20mA output of flow, totalizer, empty tube zero, 120 VAC or 24 VDC as required	Emerson • Rosemount 8700 Series ABB • MagMaster Siemens • Sitrans F M Magflo
	Magnetic flowmeter system (liquid chemical service)	Wetted parts (liner and electrodes) shall be in compliance with manufacturer's recommended materials for the chemical and concentration of the service	Emerson • Rosemount Omega
	Coriolis flowmeter system (liquid service)	Accuracy +/-0.5% of rate, isolated 4-20mA output, digital display, wetted parts compatible with process liquid per manufacturer recommendations	Emerson • Micro Motion Siemens • Sitrans F C Endress+Hauser • Promass
	Thermal mass flowmeter system (gas service)	Insertion type, 316SS process exposed parts, constant temperature type, 120 VAC, 4-20mA output, NEMA 4X enclosure	Kurz Instruments • 454FTB Series Endress+Hauser • Proline T-Mass 65I Series Sierra Instruments • Steel-Mass 640S Series
Level Measurement	Ultrasonic level meter system	Ultrasonic type, wall or pipe mount transmitter, NEMA 4X transmitter, 120 VAC, sensor on 4-inch PVC flange (or as specified), 4-20mA output, digital display	Siemens • HydroRanger 200 Endress+Hauser • Prosonic
	Radar level meter system (for water service or dusty, foggy, or pressurized/vacuum applications. Not for low dielectric materials-hydrocarbons)	Radar type, wall or pipe mount transmitter, 120 VAC, NEMA 4X transmitter, sensor on 4-inch PVC flange (or as specified), 4-20mA output, digital display	Endress+Hauser • Micropilot Siemens • Sitrans L Level Vega • Vegapuls

Pressure Measurement	RF admittance point level switch (any liquid or solid/powder)	Admittance/capacitance type, rigid probe, 120 VAC relay, 120 VAC, 5A output contacts, unaffected by coating	Ametek Drexelbrook • Multipoint II Magnetrol • Kotron Sentinel Siemens • Pointek CLS series
	Ball float (any liquid)	SS ball, Teflon coated, encapsulated switch, 1-inch differential, switch output rated 5A at 120 VAC	Siemens • 9G-EF Contegra • FS 90
	Pressure system (clean liquids or gases, gauge pressure (or hydrostatic level)	Pressure transmitter, wetted parts and body: 316SS, integral mounted transmitter (as specified), loop powered, 4-20mA output	Emerson • Rosemount 3051 CG Siemens • 7MF4033 • 7MF8023 ABB • 264HS
	Differential pressure system (clean liquids or gases, differential pressure	Differential Pressure transmitter, wetted parts and body: 316SS, integral mounted transmitter (as specified), loop powered, 4-20mA output	Emerson • Rosemount 3051 CD, Siemens • DS III ABB • 264DS
	Pressure switch	Diaphragm Actuated, field adjustable setpoint, fixed deadband (unless noted otherwise), auto reset (unless noted otherwise), NEMA 4X housing, SPDT 10A at 120 VAC output	Ashcroft • B400 series Dwyer • Mercoid D-900 SOR • SOR 401
Temperature measurement		Instrument range specified in bid specifications	
Weight measurement		Instrument range specified in bid specifications	

3.4 Control Panels

3.4.1 INTERNAL ELECTRICAL WIRING CONSIDERATIONS

- All interconnecting wiring shall be stranded, type MTW, shall have 600 volt insulation, and shall be rated for not less than 90 degrees Celsius. Wiring for systems operating at voltages in excess of 120 VAC shall be segregated from other panel wiring either in a separate section of a multi-section panel or behind a removable Plexiglas or similar dielectric barrier. Panel layout shall be developed such that technicians shall have complete access to 120 VAC and lower voltage wiring systems without direct exposure to higher voltages.
- Power distribution wiring on the line side of fuses or breakers shall be 12 AWG minimum. Control wiring on the secondary side of fuses shall be 16 AWG minimum. Sensor and probe wiring analog circuits shall utilize 18 AWG shielded, twisted pair, cable insulated for not less than CL3P or PLTC cable based on the installation.
- Power and low voltage DC control wiring systems shall be routed in separate wireways. Crossing of different system wires shall be at right angles. Different system wires routed parallel to each other shall be separated by at least 6 inches. Different wiring systems shall terminate on separate terminal blocks. Wiring troughs shall not be filled to more than 60 percent visible fill.
- Convenience receptacle shall be backed up by UPS power and shall be protected by a dedicated fuse or circuit breaker.
- Each panel shall have a single LED fixture mounted internally to the panel ceiling. Fixture shall be switched to power off with closed panel doors and shall be complete with the lamp.
- Each panel shall have a convenience outlet, mounted internally within a stamped steel device box with appropriate cover.

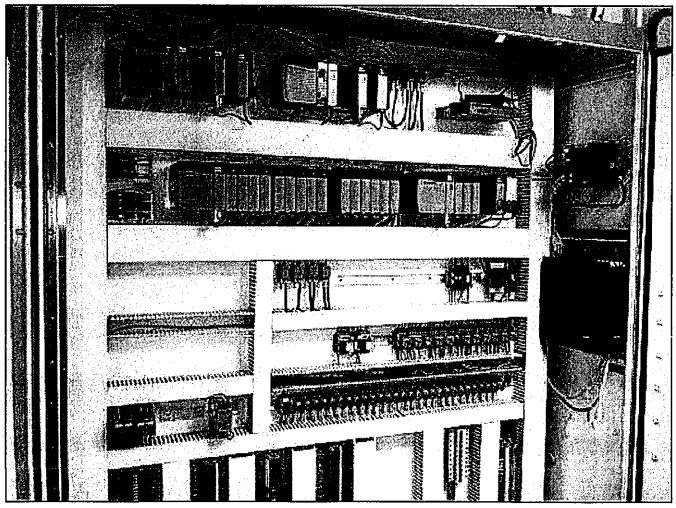


Figure 3-2 Example Minneapolis Water Control Panel

3.4.2 TERMINATIONS STANDARDS

- Unless otherwise directed by Minneapolis Water, all wiring shall terminate onto single tier terminal blocks, where each terminal is uniquely and sequentially numbered. Direct wiring between field equipment and panel components is not acceptable unless part of a UL-listed assembly specific to the application.
- Multi-level terminal blocks or strips are not acceptable unless they are approved by Minneapolis Water. If approved, they shall be mounted on angled DIN rail elevated from the back panel.
- Terminal blocks shall be arranged in vertical rows and separated into groups (power, AC control, DC signal). Each group of terminal blocks shall have a minimum of 25 percent spares.
- Terminal blocks shall be the compression type, fused, unfused, or switched.
- Discrete I/O shall have two terminals per point with adjacent terminal assignments. For inputs this would be a hot terminal and input terminal, and for outputs this would be an output terminal and neutral terminal. All active and spare PLC and controller points shall be wired to terminal blocks or an IFM card.
- Discrete PLC inputs shall be isolated with a fused terminal block or fused IFM card to protect the PLC card(s).
- Discrete PLC outputs shall be fused at minimum one fuse per PLC card.
- Analog I/O shall have three or four terminals per shielded pair connection with adjacent terminal assignments for each point. Reserve one terminal for shielded ground connection. Ground the shielded signal cable at the PLC cabinet. All loop-powered devices shall be individually fused. All active and spare PLC and controller points shall be wired to terminal blocks or an IFM card.

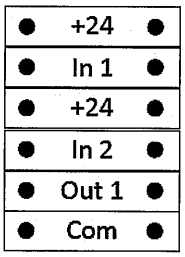


Figure 3-3 Example Terminal Block Layout

- Wire and tube markers shall be the sleeve type with heat impressed letters and numbers.
- Only one side of a terminal block row shall be used for internal wiring. The field wiring side of the terminal shall not be within 6 inches of the side panel or adjacent terminal or within 8 inches of the bottom of free standing panels, or within 3 inches of stanchion-mounted panels, or 3 inches of adjacent wireway.
- All wiring to UPS-powered devices shall be clearly identified.
- All wiring shall be clearly tagged per schematics and color-coded per **Table 3-1**.
- Each field instrument as a part of the project and shown on the drawings as deriving power from the control panel(s) shall have a separate power distribution circuit with a circuit breaker or fuse and blown fuse indication.
- Redundant 24 VDC power supplies shall be provided to power field instruments and panel devices.

- Wiring trough for supporting internal wiring shall be plastic type with snap-on covers. The side walls shall be open top type to permit wire changing without disconnecting. Trough shall be supported to the subpanel by stainless steel screws. Trough shall not be bonded to the panel with glue or adhesives.
- Each panel shall have an isolated copper grounding bus for all signal and shield ground connections. Shield grounding shall be in accordance with the instrumentation manufacturer's recommendations.
- Grounding shall comply with NFPA 70.
- Each panel shall have control, signal, and communication line surge suppression.
- All PLC and OIT devices in the panel shall be backed up by 120 VAC UPS power.
- Each panel shall have a circuit breaker to interrupt incoming power.

3.4.3 COLOR CONVENTIONS

Table 3-2 Indicator Light Color Conventions

Status	Color
Stopped / Off / Fully-closed	Green
Running / On / Fully-open	Red
Valve mid position	Blue
Fault condition	Amber or orange
Alarm condition	Amber

Table 3-3 Pushbutton/Selector Switch Type and Color Conventions

Control Signal	Operator Type	Color
Start	Momentary pushbutton	Black
Stop	Momentary pushbutton	Red
Emergency stop	Push-pull/twist maintained, large mushroom top	Red
Control mode	2 or 3 position selector switch	Black
Fault reset	Momentary pushbuttons	Black
Horn silence	Momentary pushbuttons	Black

Table 3-4 Wire and Terminal Strip Color Conventions

Function	Voltage	Wire Color	Terminal Color
Ground	Ground	Green or bare	Green or green with yellow stripe
Signal	12 VDC or 5 VDC	Purple	
Signal / Relays	4 VDC (positive or negative)	Blue or white with blue stripe	Blue
Analog – Positive	4-20 mA or 0-5 VDC	White or red in shielded twisted pair	Gray
Analog – Negative	4-20 mA or 0-5 VDC	Black in shielded twisted pair	Gray
Analog – Shielding	Grounded terminal (shield should be grounded only at PLC end)	Bare, covered in shrink tube	Green with yellow stripe
	Ungrounded terminal	Bare	Green
Externally powered circuits, interlock wiring to devices supplied by other power source	Varies	Yellow	Yellow
Power - Single Phase	120 VAC - Hot	Red (Black used in general power systems)	Red
	120 VAC - Neutral	White	White
Power - Three Phase	208-240 VAC - Phase A	Black	Grey or black
	208-240 VAC - Phase B	Red	
	208-240 VAC - Phase C	Blue	
Power - Three Phase	480 VAC - Phase A	Brown	
	480 VAC - Phase B	Orange	
	480 VAC - Phase C	Yellow	

3.4.4 EQUIPMENT SPECS AND EXAMPLE MODELS

Table 3-5 lists required instrument specs and example models used in previous installations. This product identification is not intended to limit competition, but rather to minimize the number of spare parts. This is not a representation of what devices or system will work in any future project. Specification writers may allow a bidder to provide a smaller percentage of spare parts if the exact matching parts will be installed.

Table 3-5 Control Panel Equipment Specs and Example Models

Application	Specs	Example Manufacturer/Model
Circuit breakers	DIN rail mount	Allen-Bradley • 1492-CB-1-G150 (15 A) Eaton • BR115 (15A)
Control relays	Solid state relay base Relay sockets	Alley-Bradley • 700-HN104 • 700-HN205
Convenience outlet	Common duplex receptacle, GFCI	
Enclosure	Various sizes and configurations; consider gaskets for NEMA 4X, and which direction hinged doors should open per application	Hoffman
Enclosure light	LED with push-button automatic on/off	
Fuse holders	Single-circuit fusible terminal block with LED blown fuse indicator	Allen-Bradley • 1492-H5 • 1492-WFB424 • 1492-W4P
Pilot lights	Heavy industrial grade, 30.5 mm, water/oil tight, LED-type push-to-test 120 AC, 24 DC NEMA 4X items may be a different part number	Allen-Bradley • 800T-QTH10R (or G, A) • 800T-QTH24R (or G, A) For NEMA 4X use Allen-Bradley Bulletin 800H
Power supplies	Two power supplies, both sized for 100% of cabinet load, with shunt diode transfer Each power supply shall have monitored failure indication via PLC Preferably DIN rail mount DeviceNet power supplies must be ODVA certified	Rhino IDEC Corporation • 24 VDC PS5R Series Sola/Hevi-Duty • Silver Line Series SLS-24-XXXX
Selector switches / push buttons	Heavy industrial grade, 30.5 mm, Water/oil tight Emergency stop, push-pull/twist maintained NEMA 4X items may be a different part number	Allen-Bradley • 2-position: 800T-H2A • 3-position: 800T-J2A • E-stop: 800T-FX... For NEMA 4X use Allen-Bradley Bulletin 800H
Terminal block fuses	DC fuse holder and fuse holder end barriers, indicating	Allen-Bradley • AC: 1492-H4

Terminal block jumpers	Screw center jumper 10 pole	• DC: 1492-H5 • 1492-N37 Allen Bradley • 1492-CJJ6-10
Terminal block marker cards	Marker cards for terminal blocks	Allen-Bradley • 1492-SM6X12
Terminal blocks	Single-circuit and grounding screw terminal blocks and end barriers	Allen-Bradley • 1492-J4- (color) • 1492-EBJ3
Timer relays	8-pin tube base type	Allen-Bradley • Bulletin 700-HT for low current applications Agastat for higher current applications
Wiring ducts (covered)		IBOCO • T1 Duct Series, varying sizes
Surge protection	Gas tube or metal oxide varistors	• Phoenix Contact • EDCO • Emerson Network Power
VFD	Allen-Bradley required	Allen-Bradley
Soft starters		
OIT	Standard size, touch screen	Allen-Bradley • PanelView Plus
Isolation switch block		Allen-Bradley • 1492-H7
UPS		Ferrups

3.4.5 UNINTERRUPTIBLE POWER SUPPLIES

Installation requirements include the following.

- Each plant shall have a plant-wide UPS system with all batteries kept in a common location within each plant.
- In general, UPS power shall be used to supply all panel components and field devices, including
  - PLCs and control circuits
  - Switchgear control components for incoming power systems (to allow for multiple transfers prior to a generator coming on line)
  - Analytical instruments (such as level, pressure, vibration, and temperature transmitters)
  - Computers and monitors in control rooms
  - Network communications systems
  - Security communications systems and devices
  - Any other devices necessary to monitor and/or maintain control during emergency shutdowns
- Battery capacity shall be sized to allow for a minimum of one hour power reserve at 80 percent of the total battery capacity for all connected equipment.
- All UPS systems shall be powered by on-site generators where available.
- All UPS systems shall include bypass switching to allow maintenance without interrupting power to the devices served.

3.5 Programmable Logic Controllers

The Rockwell Allen-Bradley ControlLogix series 1756 PLC family shall be used for all Minneapolis Water SCADA work. This is a proprietary procurement requirement. No equals will be considered. Embedded PLCs in vendor-furnished control panel may be Rockwell Allen-Bradley CompactLogix, MicroLogix, or Micro800 series if requested by the vendor and approved by Minneapolis Water.

Table 3-6 PLC Equipment Specs and Required Models

Application	Specs	Required Allen-Bradley Model
Processor	Allen-Bradley ControlLogix PLC platform	1756-L7X or newer
	Compact Logix	1769-L3Y, E or ER
	MicroLogix	1100, 1400, 1200
	Micro800	810, 830, 850, 820
Discrete Input	32 Discrete Input 24 VDC	1756-IB32
	16 Discrete Input 24 VDC Isolated	1756-IB16I
	32 Discrete Input (Groups of 8) 12-24 VDC	1756-IV32
Discrete Output	32 Discrete Output 24 VDC 0-30V	1756- OB32
	16 Discrete Output Individually Isolated 24 VDC 0-30V	1756- OB16I
	16 Discrete Output DC EFUSE	1756-OB16E
	16 N.O. Discrete Output Individually Isolated 5-25V	1756-OW16I
	6 Discrete Output Individually Isolated	1756-OF6VI
Analog Input	8 Analog Input 4-20mA	1756-IF8
	16 Analog Input 4-20mA	1756-IF16
Analog Output	8 Analog Output 4-20mA	1756-OF8
RTD	6 Input RTD	1756-IR6I
ControlNet	ControlNet Redundant	1756-CNBR
	ControlNet	1756-CN2R
	ControlNet	1756-CN2
	ControlNet	1756-CNB
Ethernet	Ethernet	1756-EN2T
	Fiber	1756-EN2F
DeviceNet	DeviceNet Scanner	1756-DNB
Modbus	Interface Module Modbus Master/Slave	1756-MV156
	2 Counters - 4 Outputs (2 points / group)	1756-HSC
	Slaker Weight Scale Card	HARDY-WS
	ProSoft Modbus	1756-MV146

3.6 Conduits

Installation requirements include the following.

- Conduit shall be installed per NEC.
- Conduit shall be selected with consideration of environment. All systems shall be adequately protected from physical damage.
- Design and construct to simplify future maintenance, repairs, and upgrades.
- Raceways shall be installed to drain as necessary.
- Cable trays shall be used where specified. Tray-rated cable is required in all trays.
- Confirm in-field that all conduit and cable tray ends have a smooth transition into all cabinets.
- Where multi-conductor cable is used in conduit or cable trays, at least two extra (spare) conductors per cable shall be included.
- If conductor color does not match Minneapolis Water color conventions in **Table 3-4**, then the ends of each conductor shall be taped.
- Site underground conduit shall be in concrete duct banks and have secure hand holes.
- Buried or embedded conduit should be selected per NEC.
- Tracer wire shall be included for fiber optic duct banks and conduit.
- Duct banks with medium voltage wire and cables shall be red-colored concrete.

3.7 Grounding and Shielding

NEC Article 250 covers the general requirements for the grounding and bonding of electrical installations, and emphasizes power circuit safety. Crosstalk and injection of unwanted signals into low-level data circuits and equipment shall be minimized. In order to minimize interference between equipment power and controls, the single point ground concept is recommended. The following definitions apply to the single point ground concept.

Earth ground	A high-quality earth ground to achieve lowest impedance as practical.
Site reference ground	A central ground tie point which serves as a single reference ground point for all parts of the system and the building.
Grounding circuits	Several independent insulated ground circuits are established by functional usage and all are terminated at the site reference ground point. Except for earth ground, the individual grounding circuits must be insulated from each other except at the site reference termination point. Computer cabinet and signal grounds must never share electric power ground circuits. Typically grounding circuits are established for: • Electric AC neutrals • Electrical equipment cabinet/conduit grounds • Computer/equipment cabinet grounds • Signal ground • Facility/structure ground

Site-specific grounding circuits can be established in different parts of the building, for example, all computer equipment type cabinets in a computer room may be connected by insulated cable to an insulated ground bar. This bar, in turn, is then terminated to the site reference ground. Similar arrangements can be made in other areas.

3.8 Transient Voltage Surge Suppression

Provide adequate surge suppression to protect equipment from lightening and transient voltage. Provide protection of all 120 VAC power feeds into the control panels.

3.9 Network and Communications

3.9.1 NETWORK CONFIGURATION

Operational information and process telemetry are communicated throughout Minneapolis Water via two 1 GB Ethernet communication systems. PLC controller panels are wired in a redundant loop configuration on both the Fridley campus and the Columbia Heights campus. Each major process area is supported by an area network switch.

Ethernet is used by Cimplicity HMI Servers to communicate with PLCs, historical data logging tables, Cimplicity HMI Viewers, and the Cimplicity HMI Web Server. Ethernet shall be used for PLC-to-PLC communications. The ControlLogix PLC processors communicate with remote racks via Ethernet.

3.9.2 COMMUNICATION NETWORKING CONSIDERATIONS

- Levels and locations of communication redundancy for each project and process must be evaluated with Minneapolis Water during the design phase.
- A PLC or communication link failure shall cause fail-safe conditions of the equipment.
- The use of Ethernet for end devices shall be pre-approved by Minneapolis Water (redundancy on the end devices is preferred).
- Allow for local control of all systems whenever possible; proposed exceptions shall be reviewed and evaluated by Minneapolis Water.

3.9.3 PLC COMMUNICATION

- Maintain the fiber optic communications with Ethernet/IP communications between PLCs and servers. Use fiber optic Ethernet communications down to the individual unit level.
- Ethernet is preferred for motor starters, power monitors, and VFDs.
- If analog or discrete I/O communications with valves or instruments are not coming through the Ethernet, the I/O shall be hardwired.
- Minneapolis Water fiber optic network contains multiple VLANs. Coordinate with Minneapolis Water IT for proper IP addressing.

3.9.4 COMMUNICATIONS CONFIGURATION

- Minneapolis Water SCADA network is a 1 Gbps Ethernet system. The security network is not covered by the SCADA Standard.
- All network field wiring, whether UTP, STP or fiber optic, is fixed field wiring, terminated on termination strips or light guide boxes. Only removable jumpers shall connect the field wiring to the network device or PLC.

- PLCs and HMIs communicate in a redundant loop configuration. The use of a device level ring shall be pre-approved by Minneapolis Water.
- The main light fiber is terminated into a light guide box. Network connections are then made to the area switches.
- Individual PLCs connect to PLCnet via copper if distance is under 240 feet, or via fiber using level 2 technology such as 1783-ETAP (to minimize address resolution protocol traffic) for longer distances or as directed by Minneapolis Water.
- HMIs connect to network via UTP patch panels, not directly into an area switch.
- All network cabling shall be tested to verify that it meets the network specifications for data communications rates and line loss (i.e. ODVA for DeviceNet and ControlNet, IEEE for Ethernet).
- When necessary, light fiber shall be sized to remote area switches from the light guide boxes.
- Size area switches to accommodate a UTP communications port for all connected PLCs and HMIs, plus at least 25 percent spare capacity.
- Each area switch shall be wire speed capable and managed using CISCO tools.

3.9.5 NETWORK EQUIPMENT REQUIREMENTS

Table 3-7 lists required network equipment specs and models. The purpose of this section is to promote efficiency in future maintenance and repairs. Do not deviate from the equipment listed without pre-approval by Minneapolis Water.

Table 3-7 Network Equipment Specs and Required Models

Application	Specs	Required Manufacturer/Model
Fiber optic cables	Adapter 15T - 62.5 µm multimode - ST Adapter 19T - Single-mode, UPC - LC (No ST connections on single-mode) Multi-fiber cables as needed for application Trunk fiber cables include 24 single-mode and 24 multi-mode fibers	ST® Compatible Connectors
Copper cables	Cat6 cable RJ-45 (8P8C modular) connectors	N/A
Light fiber guide box	Closet connector housing panels for ST® compatible connections Wall-mountable connector housings for remote panels Closet connector housings for rack mounting	Corning Cable Systems LANscape Solutions Products • CCH-CP • WCH • CCH
Area switches	Ethernet switches Connect redundant fiber ports ST or LC connectors	Cisco Systems • Catalyst 2960 • IE 3000

3.9.6 OFFICE DATA PORTS

Table 3-8 Standard Requirements for Office Data Ports

Data Port Type	Quantity per Desk Area	Color Code
SCADA	2	Red
Non-SCADA, CityNET	2	Blue
Telephone	2	N/A

Telephone and CityNET ports may be in the same conduit and box. Telephone and CityNET ports shall adhere to City of Minneapolis telephone and port standards. Obtain standards from the City of Minneapolis.

Electrical outlets must be placed near the ports. Supply power to computer outlets for SCADA HMIs must be backed up by UPS power.

3.9.7 INSTALLER REQUIREMENTS AND QUALIFICATIONS

- Contractors and consultants must provide Minneapolis Water with information about the data and traffic that they will be adding to the SCADA system and network.
- ControlNet, DeviceNet, and Ethernet IP networks must be initialized by personnel trained in Rockwell Automation and FactoryTalk AssetCentre.
- Fiber optic must be installed and tested by qualified Minneapolis Water personnel. Any issues discovered during verification testing must be resolved by the system integrator with no additional cost to Minneapolis Water.
- Ethernet copper cabling must be installed by qualified personnel and tested according to CompTIA/EIA Standards. The test results must be submitted as a MS Excel document.

3.9.8 COORDINATION OF PERSONAL COMPUTER PURCHASES

The general process for purchases of personal computer(s), software, or computer equipment is as follows.

A. The system integrator shall submit a specification for needed computer(s), software, or equipment to Minneapolis Water approximately three months prior to the contractor's start date for configuring each unit. Modifications to the computer specifications may be required to meet Minneapolis Water and City of Minneapolis standards. Significant modifications will be confirmed with the system integrator.

B. The system integrator shall identify which units can be configured at their location, and which units can be configured on site at Minneapolis Water. Equipment such as printers is generally held at Minneapolis Water unless there is a need to ship the unit to the contractor.

C. Minneapolis Water shall purchase computers, commercially available software, and equipment.

3.10 Radio/Wireless Communications

Any edits or changes to the radio/wireless communications system must be preapproved by Minneapolis Water.

3.10.1 MICROWAVE RADIO SYSTEM

The 5.8 GHz spread spectrum microwave radio communications system creates a wide area network connection between the Fridley campus and the Columbia Heights campus.

3.10.2 MULTIPLE ADDRESS SYSTEM RADIO

The SCADA system uses a 960 MHz multiple address system to communicate with the remote stations. This system uses GE microwave data systems (MDS) licensed radios for its MAS.

A MDS 9790 radio is connected to the server. The radio is connected to the polling master by serial cable. The master is connected to the server by Ethernet and contains the tags for the remote sites in the Fridley Cimplicity Project.

MDS 9710A radios and PLCs are at the remote locations. A laptop computer or a handheld diagnostics terminal can be connected directly to the MDS 9710A radios. The proprietary cable from Adaptive Broadband connects a laptop's serial port to the 9710A's 6-pin RJ-11 diagnostics port.

The MDS 9710A radios are connected to PLCs via a serial communications cable using the DF1 protocol. DF1 is configured to support the radio communications. Each remote site has a unique station address. A few of the basic configuration settings for DF1 slave stations are shown below. For more detailed settings, examine the PLC ladder file for the specific pump station.

- Channel 0 - System: DF1 Half-duplex Slave
- Baud: 9600 with 8 data, 1 stop bit, and no parity
- No handshaking
- CRC error correction

3.11 Schematic Conventions

All electrical schematics are considered drawings and must follow Minneapolis Water Drawing Standards (See **2.2 Drawing Conventions**), as well as the schematic formatting and number conventions below.

3.11.1 PAGE STRUCTURE

Wires and devices are identified on schematics using a column/row format. This format provides each wire and device with a unique number.

Table 3-9 Electrical Drawing Column/Row Format

Device	Column Numbers
Internal panel wiring (120v-24v) beginning with column 1 followed by external interface wiring to motor starter circuits, VFDs, valve controllers, etc.	001–199
PLC processor and card layout	200
Ethernet, and, if present, ControlNet, DeviceNet, or other communication modules	201–206 *
Other I/O modules and spares (include space for spares in actual order in drawings)	207–299 *

**Flexible based on number of communication cards in PLC rack*

Page Structure requirements include the following.

- Each column shall have ten, evenly-spaced horizontal rows that are labeled 0-9. See **Appendix C** for example schematics.
- Each wire and device description on a schematic shall contain the P&ID tagname to allow cross-referencing between tagnames and schematic identification.
- Each wire and device on a schematic shall be numbered to allow direct referencing back to the specifically related column and row number on the schematic.

3.11.2 DEVICE AND WIRE IDENTIFIER DESCRIPTIONS

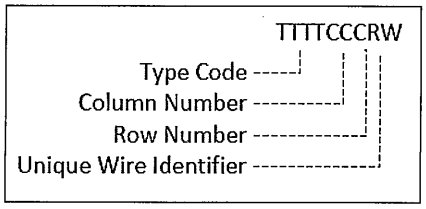


Figure 3-5 Schematic Wire Identification Pattern

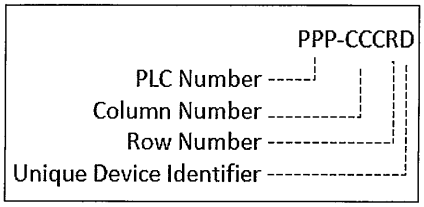


Figure 3-4 Schematic Device Identification Pattern

PLC Number	See **2.1.3 Tag Descriptions**
Type Code	See **2.1.3 Tag Descriptions**
Column Number	Three numeric characters that identify a unique column on an electrical schematic. Use preceding zero(s) for smaller columns.
Row Number	One numeric character (0 to 9) that identifies a unique row on an electrical schematic.
Unique Device/ Wire Identifier	One numeric character that uniquely identifies the device or wire. Each row can have up to 10 unique wire numbers that originate on that row.

3.11.3 SCHEMATIC IDENTIFICATION RULES

3.11.3.1 PLC I/O Cards and Rack Layout

- The processor shall always be in slot 0.
- In a schematic, each PLC card shall be labeled by the card model number, rack number, and slot number.
- The communication card shall be placed in slot 0 on all additional expansion racks.
- For each spare slot within the chassis, assign two blank columns within the drawing set (this requirement does include spare slots at the end of each chassis).
- Space shall be reserved for expansion. For example, if an 8 point analog input card is all that is needed in slot 2, show an 8 point analog input card in column 207 and reserve column 208. A single line of text, "Reserved for 16 point analog input card" shall be shown.
- Each additional expansion rack shall start on a new sheet within the drawing set.

- A minimum of one fuse shall be provided per I/O card. Fuse separately or group I/O accordingly to provide redundancy.
- Standard I/O card templates shall be provided by Minneapolis Water.
- See **4.1.4 PLC Programming** for associated programming specifications with multiple backplanes in the same panel.

Table 3-10 Example PLC Columns for I/O cards

PLC I/O Card	Columns
8 Point Analog Card	1
16 Point Analog Card	2
16 Point Digital Input Card	1
32 Point Digital Input Card	2
16 Point Digital Output Card	1

3.11.3.2 PLC I/O

- PLC I/O location in schematics shall determine wire numbers for field control and feedback.
- On a schematic, field devices that are not in the PLC panel shall be clearly labeled as being located in the field. Field devices can be boxed in a dotted line field box, or located on an electrical page (i.e. not 200+). See example schematic 202 in **Appendix C.**
- Control relay coils that control contacts shown elsewhere on the drawings, include a note on the right side of the ladder to show the column and row number of the related contact(s). Relay contacts shall be numbered to match the coil.
- All analog input circuits shall be fused individually. Use of fused IFM cards is recommended.

3.11.3.3 Wires

- Each terminal block shall be labeled to match the wire number. Terminal blocks are not considered a device; the wire number shall remain the same passing through a terminal block.
- Common wires shall have common numbers. This means that the left and right lines of every ladder (+, -, hot, neutral) remain the number at the top (or bottom) of the column. Wire row number should be applied between a device and the PLC card.
- Neutral wires in AC control power circuits shall be numbered to match the circuit breaker number, but preceded by 'N'.

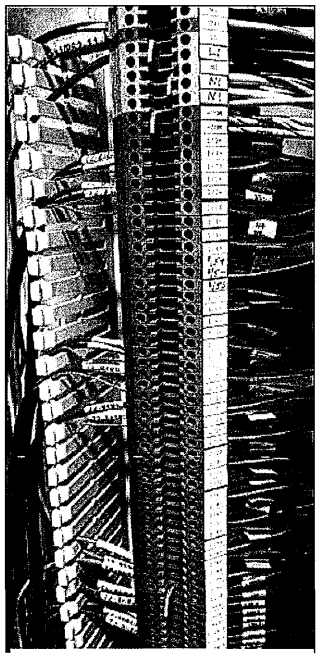


Figure 3-6 Example of Typical Wire Labeling

- References to other Minneapolis Water drawing numbers shall be included on rungs or in the lower right corner of the sheet where information is shown in a different drawing set.
- Wires numbers from field device inputs shall be obtained from the field schematic page.
- Wires numbers that originate at the PLC (outputs) shall be obtained from the PLC schematic page.
- Circuits supplying power to the equipment shall be grouped together and identified as such.

3.11.3.4 Data Communications

- ControlNet and DeviceNet cables shall be labeled following the wire numbering pattern in **Figure 3-4**. This single designation for a cable shall be carried through all panels.
- Ethernet (CATx) patch connector cables shall be labeled by Minneapolis Water using the pattern SSSS-EE-PP
  - SSSS identifies a 3-4 digit switch number
  - EE identifies a 2 digit port number
  - PP identifies a 2-3 digit PLC number
- Optical fibers shall be labeled by Minneapolis Water using the pattern XMMM - XNNN or YMMM - YNNN
  - X is internal to a building
  - Y is external to a building
  - MMM is the starting fiber number
  - NNN is the ending fiber number in a bundle

Fiber numbers are consecutive and unique to a building.

Table 3-11 Example Schematic Identifiers

Type of Identifier	Description	Identifier
Device Label	Control relay in (or connected) to Panel 54 that is on column 9 and row 17 of the schematic. This is the second control relay on this row.	054-CR0090172
Device Label	Resistive thermal detection element connected to Panel 24 that is on column 206 and row 3 of the schematic. This is the first resistive thermal detection on this row.	024-RTD206001
Wire Label	Neutral wire related to the circuit breaker on column 3, and row number 7 of the schematic. This wire number will be common to the ladder powered by this circuit. Add the panel number "PPP-" if the wire extends to the field.	N003007
Data Communications	A ControlNet cable connected to Panel 42, on column 202, and row number 9 of the drawing.	042-2029

3.12 Submittal and O&M Requirements

Documents submitted during the construction phase shall include the following.

- Equipment lists
- Electrical/layout drawings
- PLC schematics

3.12.1 INSTRUMENT DOCUMENTATION

System integrators shall supply the following with the instruments:

- Certified dimension drawings and wiring diagrams
- Installation and operating instructions
- Recommended spare parts and expendables
- Complete parts list
- Calibration curves and calculations
- Maintenance instructions
- Recommended maintenance interval
- Troubleshooting guide
- Handheld configuration devices (Review with Minneapolis Water if required)
- Applicable software

3.12.2 NETWORK DOCUMENTATION

Network documentation and drawing formatting shall be done in MS Visio.

All DeviceNet circuits shall be confirmed and documented using the following.

- Cable distances
- Power supply calculations
- Polled calculation worksheet

All ControlNet networks shall have documentation of

- I/O tree
- Node numbers
- Device type
- Firmware version
- Requested packet interval

- Electronic data sheet configuration filename

3.12.3 EQUIPMENT AND INSTRUMENT DATA SHEETS

Where ISA has developed TR20.00.01 series data sheets for particular classes of instrumentation, these must be developed, submitted, and made part of the final O&M documentation for every project.

ISA does not produce data sheets for every type of instrument category. When an appropriate sheet does not exist, the vendor or contractor shall generate a data sheet patterned after ISA format.

See **Appendix D** for example ISA TR20 data sheets.

3.13 Testing Requirements

The contractor shall coordinate with the system integrator to conduct factory acceptance tests, site acceptance tests, and system site checkout.

3.13.1 FACTORY ACCEPTANCE TESTS

3.13.1.1 Testing Plan Submittal

Provide a testing plan submittal containing test tracking sheets. Briefly describe the testing procedures for each subsystems, functions, or component. Also describe any subsystems, functions, or components that will *not* be fully tested.

Testing plan shall be submitted to the consultant and/or Minneapolis Water at least two weeks prior to commencement of factory acceptance testing.

3.13.1.2 Test Requirements

A. The system shall be tested before any major components are shipped to Minneapolis Water and early enough to allow system modification, if needed, without causing delays in equipment delivery to the site. When all major components are ready, the contractors shall demonstrate their operation as parts of subsystems and the overall control system. The test shall verify that the individual subsystems and overall control system perform according to requirements of the project manual. The factory test shall simulate a complete system, including all field I/O devices, communications equipment, software, hardware and ancillary equipment. Identify the testing location for each test.

B. Both normal operating sequences and fault conditions shall be simulated.

C. All functions of the subsystems and the overall control system shall be demonstrated. Minimum requirements for the demonstration include:

1. Designate the actual location and layout of the subsystems' and overall control system's components and demonstrate the functions and relationship of the components within the subsystems and overall control system.
2. Demonstrate operation of the overall control system and subsystems including:
    a. I/O processing
    b. Communications
    c. Alarm handling and logging
    d. HMI display functions
    e. All points necessary for report generation and historical data storage to satisfy regulatory requirements and warranty provisions
    f. All other specific functions required for complete operation of the facility
3. Demonstrate the functionality of all systems' hardware and software. The Contractor shall furnish the necessary trained personnel to perform the demonstration. The system integrator should do initial testing and troubleshooting without Minneapolis Water representatives present, and then demonstrate the functionality to Minneapolis Water and the consultant.
    a. **Hardware Test:** Components and devices shall be assembled together as they will be installed in the field and shall be tested. The test shall demonstrate proper operation of each device, and shall include verification of selected analog and discrete inputs and outputs.
    b. **Software Test:** All system software modules shall be demonstrated. Software tests shall include running all diagnostics, debugging routines, and system test routines. The operating system, advanced process control language compiler, and all associated drivers shall be fully tested and operable for the system test. Software "patches" or changes to bypass failed or flawed modules during the test will not be acceptable.
4. The overall control system and the subsystems shall operate continuously for at least 72 hours without faults. This operational test may run concurrently with the demonstration of hardware and software functions. The test procedure shall also include at least a four-hour period for discretionary tests to be conducted by Minneapolis Water or a representative of Minneapolis Water.

3.13.1.3 Post-Test Requirements and Submittals

- Contractor or manufacturer shall prepare a report from each test, and submit for review within 14 days of completion of the test (including successful and unsuccessful tests).

Arrange the report similar to the procedure document, and identify major steps and results. List all deficiencies found in the system.

- If the test is concluded unsuccessfully, the test shall be repeated.
- Following successful completion of each test, Minneapolis Water and the contractor will sign off on the test tracking sheet for that test.
- Following completion of all tests, provide Minneapolis Water with a copy of the signed test tracking sheets.
- Submit the test report and the annotated PLC logic to Minneapolis Water for review. Include status identification in the annotations such as *Post FAT* with revision date.

3.13.2 SYSTEMS SITE CHECKOUT

1. **Field check-out:** After installation and wiring connections are complete, contractor shall provide verification that all external connections to each of the subsystems and the overall control system is correctly wired and the field process components and devices are functioning as intended and as described in the control system narrative document. Connections include, but are not limited to:
    a. **Analog signals:** Analog input signals shall be simulated at the transmitting source, and verified to be received and displayed at the proper location in the control system. Analog outputs shall be generated at the control system, and verified to be received with the correct polarity and cause the proper function, at the respective receiving device.
    b. **Discrete signals:** Discrete input and output signals shall be simulated and verified that they are received at the proper voltage and cause the proper operation of the respective receiving device.
    c. **ControlNet and DeviceNet:** PLC communication systems should be tested by a Rockwell Automation network services engineer.
2. **System check-out report:** The contractor shall submit the Rockwell Automation documentation generated above to Minneapolis Water and/or the consultant. Additional documentation shall be furnished as requested by the consultant to establish responsibility for corrective measures. Contractor shall verify, in writing, to Minneapolis Water and/or the consultant that contractor has successfully completed the external connection check before beginning system startup or site acceptance testing.

3.13.3 SITE ACCEPTANCE TESTING

1. After installation and checkout by contractor's personnel, the system shall be subjected to an operational site acceptance test.

2. Prerequisites for Site Acceptance Testing shall include:

    a. Acceptance of the System Check-out Report by consultant.

    b. Acceptance of control strategy, alarms, and events as defined by process narrative by Minneapolis Water.

    c. Acceptance of submitted test procedures and the testing schedule by consultant.

    d. Submittal of preliminary operation and maintenance manuals for all systems and equipment.

3. The duration of the site acceptance test shall be set based on the complexity of the system. Adequate time must be allotted to confirm or debug all systems. The test will have three phases.

    a. **Confirmation and debugging phase:** The contractor shall test the system operation and show that all status, alarm, and process variable signals are valid and are being updated appropriately, and that the discrete and analog output signals from the control system are being correctly transmitted and implemented, and the system is operating continuously without loss of any basic functions. During this test phase, errors or abnormal occurrences shall be recorded by contractor's field representative. The representative shall inspect the system for faults and shall log or record any corrections of problems. The log shall include a description of the problem, its apparent cause, and corrective actions taken.

    b. **Demonstration phase:** The demonstration test will be a set period for contractors to demonstrate effective operations to Minneapolis Water and consultant. In the event of repeated failure of any component or functions, the acceptance test shall be terminated and re-started after corrections have been made. During the latter part of the demonstration period, reserve at least a four-hour period for discretionary tests to be conducted by the Minneapolis Water or consultant.

    c. **Normal operation simulation phase:** Before the site acceptance testing will be considered complete, the system must be confirmed by normal operation for 7 calendar days without error.

        1. **Failure of redundant equipment:** Failure of redundant equipment shall not be considered downtime provided that automatic failover occurs as specified and, in the opinion of consultant, the failure was not caused by deficiency in design, fabrication, or installation.

4. **Completion of Test:** Successful completion of the site acceptance test, including the operational simulation, is a prerequisite to substantial completion as specified in the project's contract conditions.

3.13.4 TESTING AND COMMISSIONING FORMS

The forms in **Appendix E** present acceptable format and content requirements for each type of testing or commissioning represented, and represent a minimum requirement for the development of similar testing forms for other equipment or processes not shown.

3.14 Training Requirements

3.14.1 OVERVIEW

Minneapolis Water plant personnel shall receive training and instruction on all new SCADA-affected equipment, controls, and processes. The cost of training programs to be conducted with plant personnel shall be included in the contract price.

The training and instruction shall be directly related to the system being supplied. The training program shall represent a comprehensive program covering all aspects of the operation and maintenance of the system.

Training shall accomplish the following:

- Provide instruction covering use and operation of the equipment to perform the intended functions.
- Provide instruction covering procedures for routine, preventative, and troubleshooting maintenance.
- Explain procedures for placing the equipment in and out of operation and explain necessary actions and precautions to be taken regarding the overall instrumentation and control system.

3.14.2 RESPONSIBLE PERSONNEL

The system integrator is responsible for training unless otherwise specified.

- The contractor shall retain the services of the system integrator to provide O&M training for all plant monitoring and control system equipment as specified. The credentials of the proposed trainer(s) shall be submitted to Minneapolis Water for approval, including the trainer's name, education, knowledge of the equipment or systems, experience as a trainer and employment history with the manufacturer or system integrator.
- For equipment not manufactured by the system supplier, the supplier shall provide on-site training via an authorized representative of the equipment manufacturer. The manufacturer's representative shall be fully knowledgeable in the operation and maintenance of the equipment.

- Prior to site acceptance tests, retain qualified representatives of the system integrator and equipment manufacturer to instruct on-site Minneapolis Water personnel. The qualified representative of the system integrator and equipment manufacturer shall provide, at minimum, the number of hours noted below (subject to modification on a project by project basis during design).

3.14.3 SCHEDULING

- Training hours specified are minimum classroom or hands-on time, and do not include travel, setup, or cleanup time by the instructor. Each day of training may include repeat for two shifts.
- All training schedules shall be coordinated with, and at the convenience of Minneapolis Water. Shift training may be required to correspond to Minneapolis Water' work schedules.
- Training classes shall be scheduled a minimum of two weeks in advance. Proposed training material, including a detailed outline of each lesson, shall be submitted to Minneapolis Water/consultant at least 30 days in advance of the proposed training. Minneapolis Water/consultant will review the submitted data for suitability and provide comments that shall be incorporated into the course.

3.14.4 TRAINING TOPICS

Prior to factory acceptance testing, the system integrator shall submit a list of training sessions and indicate the minimum training duration and number of attendees for the following areas:

- Process controller hardware familiarization, operator interface configuration and process controller programming including I/O familiarization, ladder logic programming, and register mapping.
- HMI software configuration including database development, displays, reports, alarming, and analog trending.
- HMI hardware and networks including operating system administration requirements, new users, security levels, virus protection, backups, archives, and other routine maintenance.
- Communication system configuration including system configuration, system architecture, and equipment familiarization.

3.14.5 TRAINING MATERIALS

- The supplier shall provide detailed O&M manuals to supplement training.
- The supplier shall make use of teaching aids such as manuals and slide shows, and video presentations. All teaching aids shall subsequently be made available to Minneapolis Water.

4.0 SCADA Programming Standards

4.1 Programmable Logic Controllers

4.1.1 COORDINATION OF CONSTRUCTION WITH MINNEAPOLIS WATER

During the early phase of construction, the system integrator shall work with Minneapolis Water to coordinate new PLC programming with existing programs:

- Review of process narratives
- Review of existing programs
- Review of existing P&ID and schematic as available

System integrators shall provide the following in FactoryTalk AssetCentre.

- 20 percent annotated PLC programs for discussion
- Annotated PLC programs prior to factory and site acceptance tests
- Annotated PLC program files at substantial completion
- Final annotated PLC program files

4.1.2 PLC PROCESSORS

See **3.5 Programmable Logic Controllers** for equipment requirements.

4.1.3 SOFTWARE REQUIREMENTS

It is preferred that all PLC programming shall be done in relay ladder logic using RSLogix 5000 or Studio5000, version shall be confirmed with Minneapolis Water. Other programming methods may be approved by Minneapolis Water under certain circumstances.

4.1.4 PLC PROGRAMMING

- Standard rung programming blocks in the Rockwell software shall be used. Add-on instructions shall not be created without prior approval by Minneapolis Water.
- All PLC programs shall include the following documentation.
  - Rung comments (shall describe the desired action of the rung or group of rungs)
  - Address descriptions
  - Tagnames
  - Symbols
- If the PLC backplane is in the same panel as the processor, then the names and base tags shall match the PLC number. If the backplane of the remote I/O panel is in a different panel than the processor, then the names shall refer to the processor PLC number; base tags refer to rack number.

- OITs shall be Ethernet devices.
- ControlNet nodes shall be in sequential order.
- Scheduled maximum node number (SMAX) shall be equal to highest scheduled node number and unscheduled maximum node number (UMAX) shall be equal to SMAX +4.
- ControlNet network update time (NUT) shall be set to maximize efficiency.
- The communications format for produced and consumed tags between processors shall be 'None'. The communications format for remote racks shall be 'Rack Optimized'.
- Unconnected buffer code is required and the maximum number of buffers of the processor type shall be implemented. The check for the maximum number of buffer shall off the S:FS bit.
- Firmware revision in I/O tree shall match actual device exactly to minor revision.
- Requested packet interval (RPI) is required and shall be:
    - 60ms for discrete cards
    - 120ms for analog cards
    - Consume tags shall be no faster than 60ms or binary multiples of the NUT up to 128 times the NUT
- The PLCs use specific programming to accurately capture 15 minute accumulated flows for specific flow streams as identified by Minneapolis Water. See **Appendix F** for an example of ladder logic calculating a 15-minute accumulated flow.

4.1.5 PLC TAGNAMES AND SYMBOLS

Tagnames and symbols for addresses directly related to field I/O points, either by derivation or function, shall use the field tagname at the beginning of the tagname or symbol name for that address. Tagnames in the program shall match tagnames in the schematic. See **2.3 Tagnaming Conventions** and **3.11 Schematic Conventions**.

4.1.6 EQUIPMENT REGISTER ALLOCATION

This section is intended to promote easy troubleshooting through the use of bits that are assigned by process function, and is not applicable if using add-on instructions.

To maximize program efficiency, discrete data shall be grouped into DINT (32 bit) words. Bits 16 through 31 are assignable. Bits that are part of a subroutine shall be grouped together. See **Table 4-1** and **Table 4-2** for examples of typical PLC motor and valve events.

Table 4-1 Typical PLC Motor Events

Bit	Description
0	Operator Tagged – TG (virtual)
1	Remote – YN (field)
2	Running – MN (field)
3	Interlock (internal based on field)
4	Not Used
5	Operator Automatic – AM (virtual)
6	Operator Start – MD (virtual)
7	Operator Stop – MB (virtual)
8	Operator Reset – RE (virtual)
9	Not Used
10	Automatic Start (PLC)
11	Automatic Stop (PLC)
12	Common Fail Lockout – CF (PLC)
13	Desired State (1=RUN) (PLC)
14	Start internal (PLC)
15	Stop internal (PLC)

Table 4-2 Typical PLC Valves Events

Bit	Description
0	Operator Tagged – TG (virtual)
1	Remote – YN (field)
2	Full Open – ZH (field)
3	Full Closed – ZL (field)
4	Operator Stop – ZZ (virtual)
5	Operator Automatic – AM (virtual)
6	Operator Open – ZD (virtual)
7	Operator Close – ZB (virtual)
8	Operator Reset – RE (virtual)
9	Not Used
10	Automatic Open (PLC)
11	Automatic Close (PLC)
12	Common Fail Lockout – CF (PLC)
13	Not Used
14	Desired Opened internal (PLC)
15	Desired Closed internal (PLC)

4.1.7 PROGRAMMING MODULES

When possible, rungs of the PLC logic shall be organized so that control functionality for individual motors and valves is grouped together.

Typical programming modules include

- Motor On/Off Control
- Motor Speed Control
- Valve Open/Close Control
- Valve Position Control
- Analog Input Handling
- Analog Output Handling
- PID Controller

Example functionality of a motor control module

- Monitors the remote/local switch and only attempts to control in remote
- Bits for operator selectable automatic and manual mode
- Bits for automatic control requests from other routines
- Bits for manual control requests from HMI
- Generates an alarm when the motor fails to start or stop when requested
- Generates an alarm when the motor stops unexpectedly
- Captures pertinent fault information
- Locks out remote control functionality in the event of a failure
- Allows for interlocks to lock out control
- Allows for software-based red tag condition from HMI
- Tracks motor runtime and starts
- Permits hard wired bumpless transfer from local to remote

4.2 Human Machine Interface

4.2.1 INTRODUCTION

This section defines configuration and programming standards for the SCADA system databases and user interfaces. HMIs provide monitoring and control capabilities, alarming, and trends.

4.2.2 SOFTWARE REQUIREMENTS

OITs at Minneapolis Water use the HMI application FactoryTalk View Machine Edition (ME) by Rockwell Automation.

OWSs at Minneapolis Water use the automation platform Proficy HMI/SCADA – Cimplicity by GE Intelligent Platforms.

4.2.3 GENERAL REQUIREMENTS

- Minneapolis Water shall assign permission levels to configure users with editing permissions and view-only permissions.
- Graphical interface design shall be as consistent as possible between OITs and OWSs.
- Complicity Projects and screens must be functional within WebView to allow user access to information over the Minneapolis Water intranet. Among other limitations, arrays may not be used for screen variables.
- Screens shall be designed to allow cross referencing of tagnames within Cimplicity. The Cimplicity tool Point XRef Explorer shall be able to search and find any selected tag on all screens where it is used, to allow changes to that tagname. Cross-referencing only reaches a limited number of layers; therefore grouping shall be limited to two layers.

4.2.4 CIMPLICITY CONFIGURATION

A complete Cimplicity project is comprised of the following components.

- Cimplicity database
- Device communication between server and PLC
- Historical data logging and trending
- Alarming
- Security
- Graphical user interfaces
- Report generation

The flow of data between Cimplicity and the other parts of the SCADA system is shown in **Figure 4-1.**

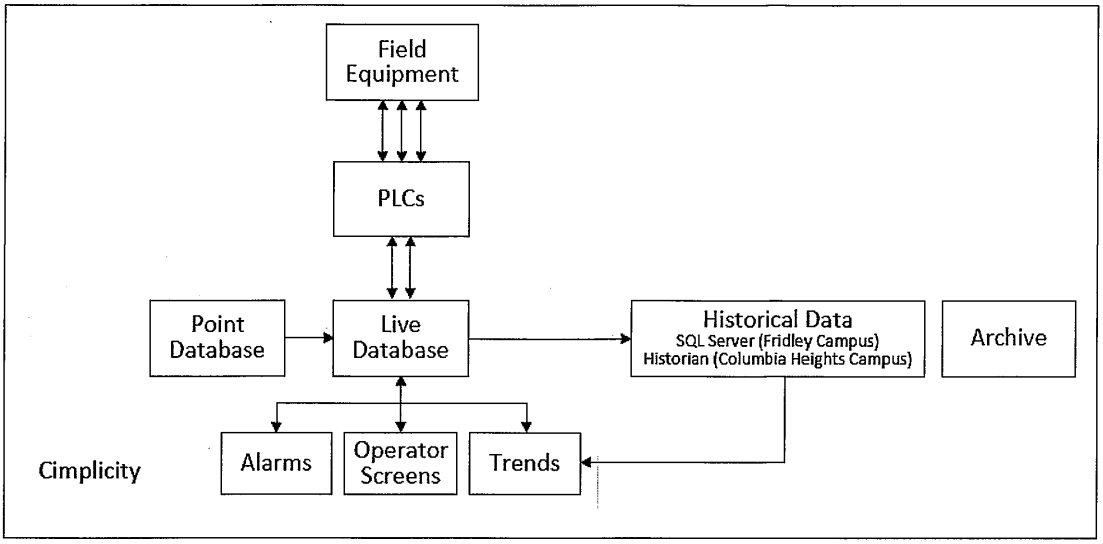


Figure 4-1 Cimplicity Data Flow

Cimplicity communicates with PLCs via the network. See **Section 3.9 Network and Communications.**

A runtime database, or "live" database, operates in real-time to update data from the PLCs. Operator screens, alarms, and Quick Trends are connected to points in the live database.

Cimplicity logs data, alarms and events to a historical database server. The logged data is used to generate Cimplicity trends. Users also can retrieve alarms and events from the alarm and event logs.

4.2.5 DATA STORAGE

Operational historical data for both the Fridley campus and the Columbia Heights campus is stored in GE Proficy Historian. Data storage frequency is commonly 1-minute intervals and may be stored as an "average" over each storage interval or as an instantaneous point recorded once in each storage interval. The most appropriate data storage option for each given data point shall be determined during design.

4.2.6 DATABASE POINTS

4.2.6.1 Point Configuration

Each database point is either addressed to a memory location in the PLC or contains virtual information for use only in the Cimplicity system. Each point has fields that must be configured, including:

- Unique tagname that corresponds to the field I/O address used in the PLC documentation and schematics
- Description
- PLC address
- PLC device communication information
- Alarm configuration
- Range
- Setpoint limits
- Security resource

4.2.6.2 Point Tagnames

Virtual point names shall follow tagnaming conventions. See **2.3 Tagnaming Conventions.**

Live point names shall match the PLC tags.

4.2.6.3 Point Types

Minneapolis Water has established the following practices for the use of analog, Boolean, and virtual points.

- Analog points
  - Tied to registers in the PLCs
  - Contain process data such as flows and levels
  - Usually either 16-bit integer registers or 32-bit real registers
  - Capable of either monitoring or control
- Boolean points
  - Tied to bits in the PLC memory
  - Contain discrete states, such as ON/OFF status
  - Capable of either monitoring or control
- Virtual points
  - Analog or Boolean points internal to the Cimplicity project
  - Not tied to PLC memory

Controlled points are called setpoints. Setpoints display the current value in the PLC and allow new values to be written to the PLC.

The requirements for each point determine which database point will be used. **Table 4-3** lists the type of point that shall be used for each function.

Table 4-3 Typical Point Usage

Function	Point Type	Control Allowed?
Monitor an analog field instrument	Analog	No
Monitor a discrete field event or alarm	Boolean	No
Analog setpoints in the PLC	Analog	Yes
User actions, such as START, sent to the PLC	Boolean	Yes
Virtual software points such as yellow tag	Virtual	Yes

4.2.6.4 Operator Outputs

Setpoints shall be configured for every controlled device to allow the user to send commands to the PLC. **Table 4-4** lists standard points for operator outputs.

Table 4-4 Points for Operator Outputs

Command	Block Type	ID
Start Command	Boolean point	_MD
Stop Command	Boolean point	_MB
Reset Faults Command / Reset Alarm Command	Boolean point	_RE
Equipment Tagged Out of Service - Red	Boolean point	_TGR
Equipment Tagged - Yellow	Virtual Boolean point	_TGY
Manual / Automatic	Boolean point	_AM
Open Command	Boolean point	_ZD
Close Command	Boolean point	_ZB

4.2.7 ALARM AND EVENTS INFORMATION MANAGEMENT

Alarms and events shall be processed by Cimplicity and stored in the historical database. Each alarm's priority is assigned based on the response-time needed for the situation. Alarm messages shall be clear and unique to allow the appropriate intervention to occur. Table 4-5 provides a summary of criteria for setting alarm priorities.

Table 4-5 Alarm Priority General Criteria

Priority	Description
High	Condition requires intervention by a person within 15 minutes. The PLC will also need to act immediately to protect the system in addition to operator intervention.
Medium	Condition requires intervention by a person sometime during the same day or shift. Typically the PLC will react first to stop a unit with a problem and start a redundant unit. This level alarm alerts operations to correct the problem for the failed unit.
Low	Condition requires intervention by a person within 1 to 3 days.
Event	Action that is recorded to allow review or confirmation at a later date.

4.2.8 SCREEN STANDARDS

Standardized screen format, elements, and functions provide the user with a consistent representation of information and standard patterns for user action. Screens shall use standard and consistent symbols, buttons, navigation, and hierarchy in all process areas.

4.2.8.1 Hierarchy

HMI screens are organized in a hierarchy as shown below.

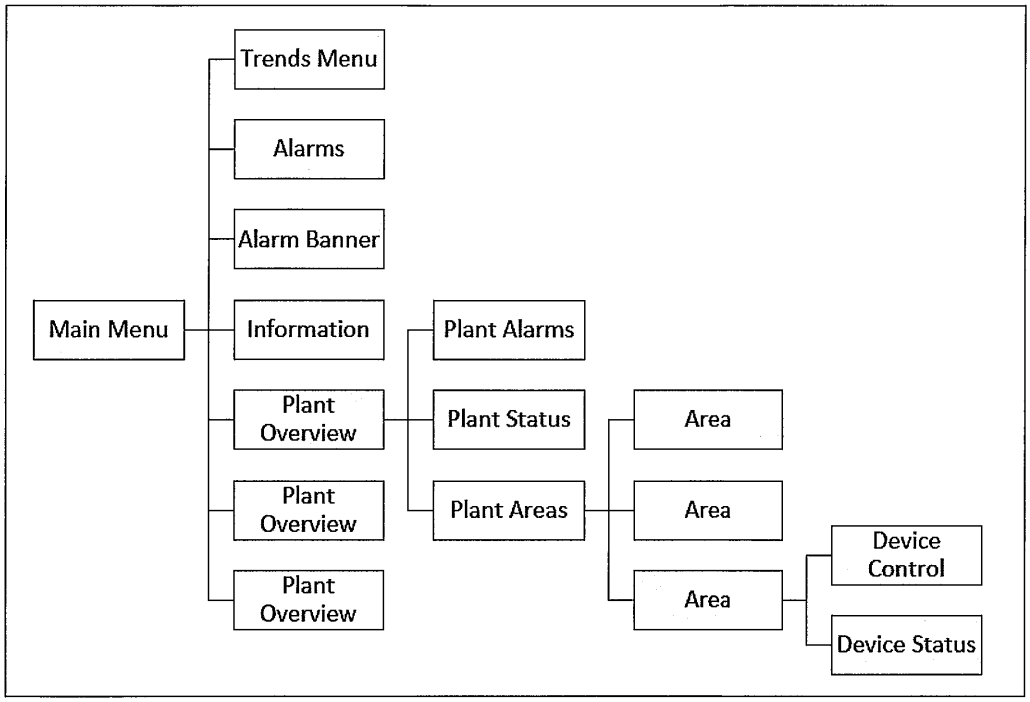


Figure 4-2 Screen Hierarchy

4.2.8.2 Screen Types

Overview screens show a major system or building. Process data displayed is limited to critical system data. The user cannot control devices or processes from an overview screen.

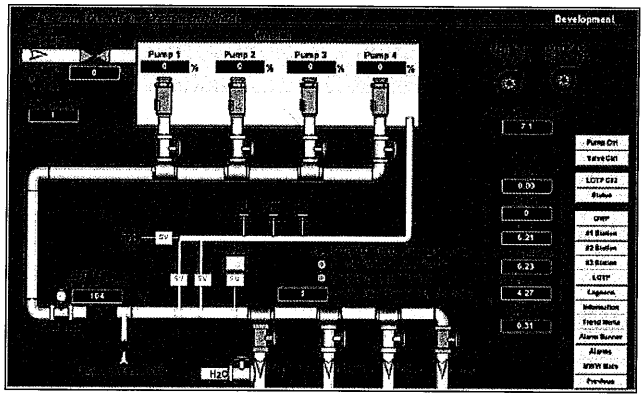


Figure 4-3 Example Plant Overview Screen

- Large geographic area
- Limited process data
- No control
- Access to overview screens
- Access to area screens

Area screens show a detailed overview of a system. System process data is displayed. The user cannot control devices or processes from an area screen. Some locations such as remote pump stations only have an overview screen.

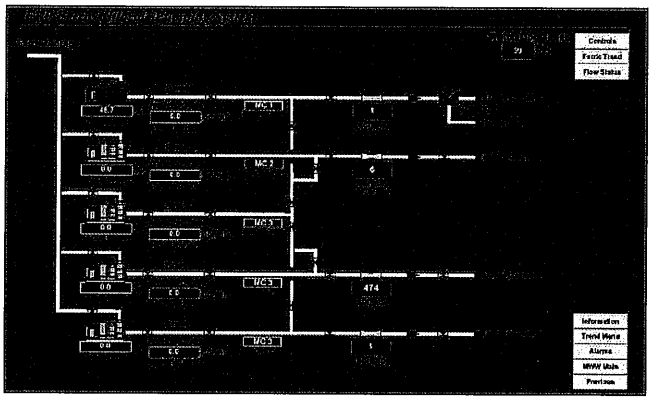


Figure 4-4 Example Area Screen

- Process area
- Detailed system data
- No control
- Access to device screens
- Access to area screens

Control screens give users control of processes and individual devices. Control screens also display device and process data.

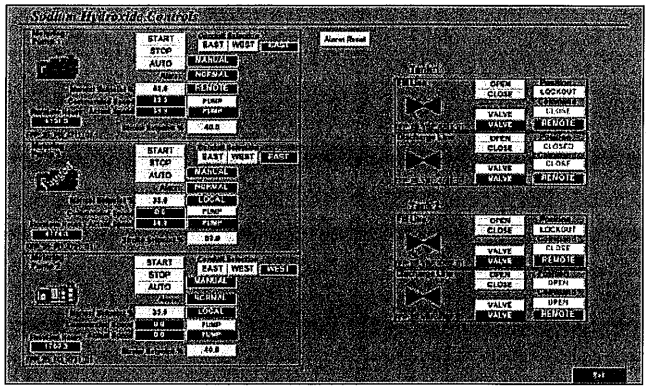


Figure 4-5 Example Device Control Screen

- Process data
- Process control
- Device data
- Device control
- Must return to area screen

Status screens display all process data for a major system or building, area, or device. The user cannot control devices or processes from a status screen.

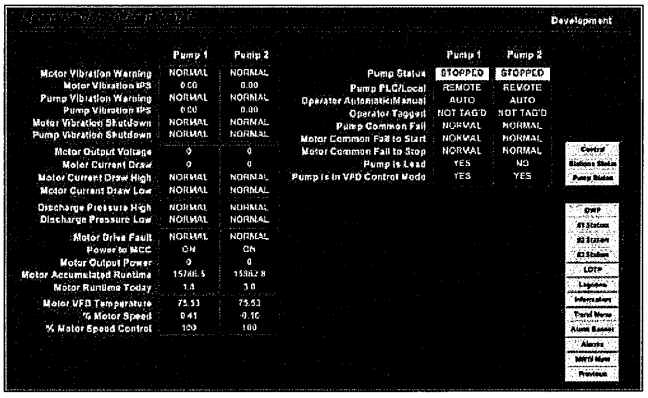


Figure 4-6 Example Device Status Screens

- Detailed plant, system, and/or device data
- No control
- Access to related overview, area, and device screens

Trend screens display graphical representations of process variables. Each trend recalls historical data. A vertical line on the graphic can be slid from left to right to give the exact value of each line at any point of time shown on the trend. Data is shown using color-coded pens.

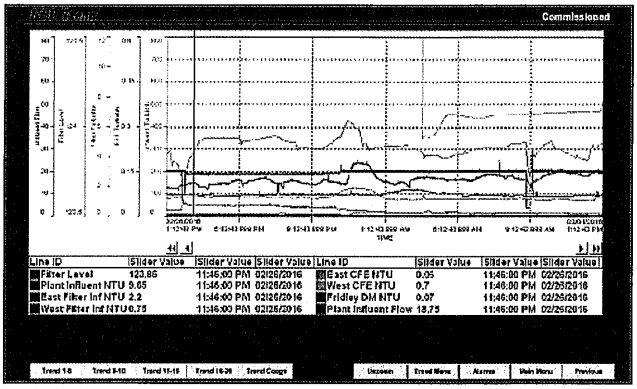


Figure 4-7 Example Trend Screen

Alarm screens show device and process alarms. The user can view and acknowledge all alarms from a full sized main alarm screen or from an alarm banner. The banner provides a limited number of recent alarms and fits at the bottom of the monitor below other screens.

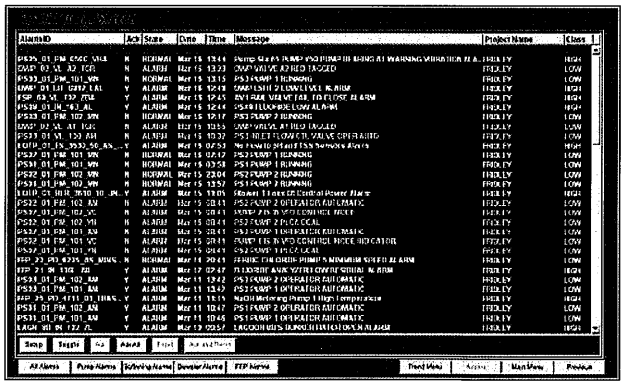


Figure 4-8 Example Main Alarm Menu

4.2.8.3 Screen Naming Conventions

Screens are named according their type so that Microsoft Windows performs an alphabetical sort of the screens by type. Screens shall be named using the following format:

type_facility_detail.cim

Table 4-6 Screen Naming Conventions

Screen Type	Naming Convention	Example
Overview Alarm	a_alarm_name.cim	a_alarm_main.cim
Area Screen	a_screen_name.cim	a_hilltop.cim
Control Screen	c_screen_name.cim	c_ps05_hs.cim
Status	s_screen name.cim	s_ps03_pump1.cim
Menu Screen	m_screen_name.cim	m_main.cim
Overview Screen	o_screen_name.cim	o_chfp.cim
Training Reference	r_screen_name.cim	r_st_navigation.cim
Trend Screen	t_screen_name.cim	t_ps03_12hour.cim

4.2.8.4 Screen Background and Title Conventions

Table 4-7 Screen Background Colors

Screen Type	Screen Background Color
Menu screens	Teal
Plant overview screens	Teal
Area screens	Teal
Status screens	Teal
Control screens	Grey

Each screen shall have a title and development status displayed on the top left-hand corner and the top right-hand corner, respectively.

Table 4-8 Screen Title and Development Status Fonts

	Font and Style*	Font Size	Font Color
Screen title	Times New Roman, italic	18 pt.	Navy
Screen development status	Arial, bold	12 pt.	White

*All text is sentence-case unless otherwise noted

4.2.8.5 Navigation

4.2.8.5.1 NAVIGATION CLUSTERS

Screens are navigated using buttons. Navigation buttons shall be stacked vertically on the right-hand side of the screen, starting at the lower right-hand corner.

A standard cluster of navigation buttons shall be on the main menu, as well as every plant overview screen, area screen, and status screen. The buttons in the navigation cluster shall not vary from screen to screen. See **Figure 4-9** for which buttons shall be included.

Once the user has navigated to a plant overview or plant status screen from the main menu, a site-specific navigation cluster shall be available above the standard cluster. Site-specific clusters allow the user to move between screens associated with the site: area screens, status screens, device screens, control screens, and related plant overview screens. The buttons available to the user shall change depending on which level of screens the user is on (i.e. the user cannot jump directly from the overview screen to a device control screen). See **Figure 4-9** for an example site-specific navigation cluster.

Control screens do not have navigation clusters. An 'Exit' button shall be located on the bottom right-hand corner of each control screen.

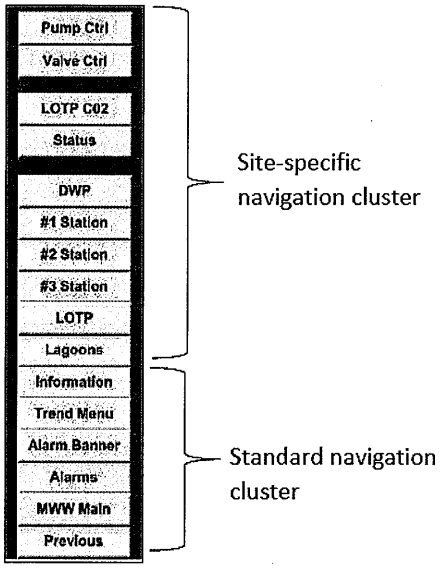


Figure 4-9 Navigation Clusters

4.2.8.5.2 NAVIGATION BETWEEN SCREENS

The main menu screen gives access to overview screens, site status screens, and standard navigation cluster. From a plant overview screen, the user can access plant's area screens and other related overview screens. From each area screen the user can access the area's device screens, the

plant's other area screens, or return to the overview screen. Control screens do not have navigation clusters. The user must exit out of a control screen, which shall return the user to the area screen.

4.2.8.5.3 NAVIGATION BUTTONS

Table 4-9 shows the typical buttons used to navigate the screens and the standard label that shall be used for each button.

Table 4-9 Standard Navigation Button Labels and Actions

Button Label	Action
Alarm Banner	Calls the alarm banner
Alarms	Calls the main alarm screen
Control [TTT]	Calls the control screen for the process
Status	Invisible on the device; calls the status screen for the plant, system, or device
Exit	Used on control graphics to exit the screen
Information	Calls the on-line training screens
Main Menu	Calls the main menu screen
Overview [plant/system name]	Calls the plant overview screen
Previous	Calls the previous screen
Trend	Calls the trend related to that display
Trend Menu	Calls the trend menu screen

Table 4-10 Navigation Buttons Style Conventions

	Button Color	Label Font/Style*	Label Size	Label Font Color
Navigation cluster buttons	Light grey	Arial, bold	8-12 pt.	Black
Exit button	Red	Arial, uppercase, bold	8-12 pt.	White

*All text is sentence-case unless otherwise noted

4.2.8.6 Device Operational Modes

The operator switches a device between local mode and remote mode from the device's control mode field switch. The selected mode shall be displayed in the device's dynamic data fields (see **4.2.8.10 Dynamic Process Data**).

Local mode	If a remote-local selector switch is placed in local mode, then the device is controlled in the field from a local control panel. The device's dynamic data fields shall display 'LOCAL', or, if space is limited, 'L' (see **Figure 4-14**).
Remote mode	If a remote-local selector switch is placed in remote, then control of the device is passed to the PLC. The device's dynamic data fields shall display 'REMOTE', or, if space is limited, 'R'

If a device is in remote mode, then the operator sets the device to either remote-manual mode or remote-auto mode from the device control screen. This sets the auto/manual bit for the device in the device status register (see **4.1.4 PLC Programming Standards**). The selected mode shall be indicated in the device's dynamic text fields.

Manual mode	The device is controlled by an operator from an OIT or OWS control screen. The device's dynamic data fields shall display 'MANUAL', or, if space is limited, 'M'.
Automatic Mode	The device is receiving commands from, and is controlled automatically by, the PLC. Automatic mode typically requires an operator-entered setpoint such as desired flow. The device's dynamic data fields shall display 'AUTO', or, if space is limited, 'A'.

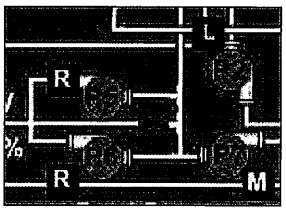


Figure 4-10 Example of Simple Dynamic Text Fields

4.2.8.7 Device and Process Control

On a control screen, the control actions for each device and process shall be contained within a control cluster. Depending on the device or process, a control cluster may include control buttons, operational mode settings, user-entered setpoints, process parameters, and status fields. In a limited number of cases for critical equipment, the control action brings up a confirmation to verify that the control action is desired.

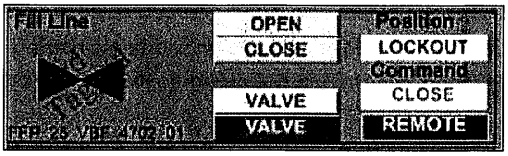


Figure 4-11 Example Device Control Cluster

Setpoints are analog control variables sent to the PLC for the purpose of controlling speed, position, level, or flow. Select setpoints are supervisory-level only; setpoints with such restrictions shall be identified during the development of the process narrative, and configured appropriately in the point database.

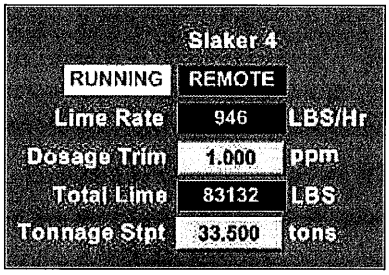


Figure 4-12 Example Setpoint Buttons and Dynamic Data Fields

Table 4-11 Navigation Buttons Style Conventions

	Button Color	Label Font/Style*	Label Size	Label Font Color
Control buttons	Light grey	Arial, uppercase, bold	8-12 pt.	Black
Setpoint buttons	Light grey	Arial, bold	8-12 pt.	Black

*All text is sentence-case unless otherwise noted

4.2.8.8 Device Tagging

Minneapolis Water uses a tagging system that is intended to reflect all tags applied in the field. The following standards shall apply.

- A yellow tag indicates "Caution" and tells the operator that there is a problem with the device, but that the device can be operated manually in an emergency.
- A red tag indicates "Danger" and tells the operator that they must not try to start the device.
- If a device is yellow-tagged or red-tagged in Cimplicity, automatic operation shall not occur from Cimplicity screens.
- Buttons for applying a red or yellow tag to a device shall be included in the device's control cluster. See **Figure 4-10** for an example.
- When a device is tagged, a diagonal indication shall be displayed across the device symbol, as shown in **Figure 4-13.**
- When a device is tagged, a comment button shall appear adjacent to the device symbol on the area screen, as shown in **Figure 4-13.** The button shall open a text file. Users enter the date the tag was applied, the color of the tag, the name of the person applying the tag and a brief explanation. The date and name of person removing the tag should be noted at the time of tag removal.
- A tag shall be cleared by pressing the tagging button again.
- Alarms may be suppressed when equipment is red-tagged.

Figure 4-13 Example Tagged Device and Comment Box

Table 4-12 Tagging Buttons Style Conventions

–	Button Color	Label Font/Style*	- Label Size	Label Font Color
Yellow tag button	Yellow	Arial, uppercase, bold	8-12 pt.	Black
Red tag button	Red	Arial, uppercase, bold	8-12 pt.	White
Comment button	Light grey	Arial	8-12 pt.	Black

*All text is sentence-case unless otherwise noted

4.2.8.9 Alarm Acknowledgement

Alarm screens and the alarm banner shall have buttons to allow the user to acknowledge and/or reset alarms.

- Alarms displayed to operators can be filtered for individual working areas. Alarms can be filtered so that the resource of the tag matches the security resource of the operator.
- An audible alarm shall sound with each new high priority alarm.
- Alarms shall follow the color conventions in **Figure 4-13**.
- If an alarm is not acknowledged, the 'Acknowledged' field ('Ack') shall display an 'N'.
- If an alarm is acknowledged but it is still in alarm condition, the alarm shall stay displayed on the alarm screen and the 'Ack' field shall display a 'Y'.
- If an alarm is acknowledged and it is no longer in alarm condition, the alarm shall disappear from the alarm screen.
- An alarm must be acknowledged before it will disappear, even if it returns to normal before it is acknowledged.

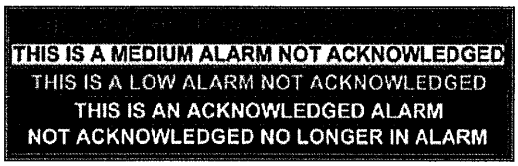
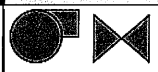
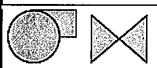


Figure 4-14 Alarm Colors

4.2.8.10 Dynamic Symbols

Dynamic symbols shall be used whenever the operating status or position of a device is monitored. The dynamic equipment symbols will be assigned to the binary inputs that reflect the status of the device:

Table 4-13 Device Status and Dynamic Symbol Color

Device Status	Color	Example
Stopped / Off / Fully-closed	Green	
Running / On / Fully-open	Red	
Valve mid-position	Blue	
Valve error (both limit switches energized)	Blue flashing	
Signal not connected/loss of power	Black	
Failed	Flashing (last state color)	
Static (not monitored)	Grey	

4.2.8.11 Dynamic Process Data

Dynamic process data consists of dynamic numbers and dynamic text. Dynamic numbers are monitored analog data received from the PLCs (e.g. speed, position, level, and flow). Dynamic text is monitored Boolean values in Cimplicity, which receive data from the PLCs (e.g. device operating mode and status).

Font and color standards are shown in **Table 4-12**. If power is lost, the dynamic text field shall default to 'ERROR' or "NO DATA'.

Figure 4-15 Dynamic Analog Data

Figure 4-16 Dynamic Boolean Data

Table 4-14 Dynamic Data Font and Color Conventions

	Font and Style*	Font Size	Font Color	Text Field Fill Color	Text Field Border
Dynamic numbers	Arial, bold, uppercase	8-12 pt.	White	Black	White, thin
Dynamic text: operating mode	Arial, bold, uppercase	8-12 pt.	White	Black	White, thin
Dynamic text: Device status	Arial, bold, uppercase	8-12 pt.	Text color shall match dynamic symbol color conventions **(Table 4-13)**	White	White, thin
Static text	Arial, bold	8-12 pt.	Generally black or white, depending on background	None	None

*All text is sentence-case unless otherwise noted

4.2.8.12 Static Text

Static text is not updated from the PLC, nor does it provide control actions. Static text includes titles, equipment descriptions, and engineering units. See **Table 4-14** for font conventions.

4.2.9 COORDINATION, SUBMITTALS, AND REVIEW PROCESS

- The data storage and basic screen outline shall be created during design. This includes a list of tagnames for screen control and monitoring, a list of alarm points, and a list of trend points. Frequency of update to each of these will also be included at design phase for Minneapolis Water review.
- The system integrator shall provide Minneapolis Water with a list of proposed database points. Database points shall be configured in Cimplicity prior to screen development.
- Items/events to be alarmed and trended shall be identified during the design phase and reviewed with Minneapolis Water.
- Screens shall be reviewed with Minneapolis Water operations, engineering, and maintenance staff.
- During the early phase of construction, the contractor shall submit their proposed integration plan for review by and discussion with Minneapolis Water.
- During construction, the contractor shall provide setpoints for each alarm and any equations to determine setpoints, based on the criteria in **Table 4-5**, and then then submit a proposed alarm list for review by and discussion with Minneapolis Water.

4.2.10 ROUTINE REPORTS DEVELOPMENT

Each plant has regularly-scheduled reports. The reports are created from data that is automatically recorded by the SCADA system. Reports are generally generated, but there are exceptions. In general, reporting will be divided into two types: regulatory and operational.

- Regulatory reports will be submitted to regulatory agencies such as the Minnesota Department of Health, and must be formatted as specified by the agency.
- Operational reports will contain data to assist in long term tracking of plant performance and efficiency, such as chemical consumption, electric power use, and other parameters. Minneapolis Water will work with contractors to confirm these reports are clearly formatted.

A plan for routine reports will generally be developed during the design phase.

4.2.11 SCREEN VALIDATION

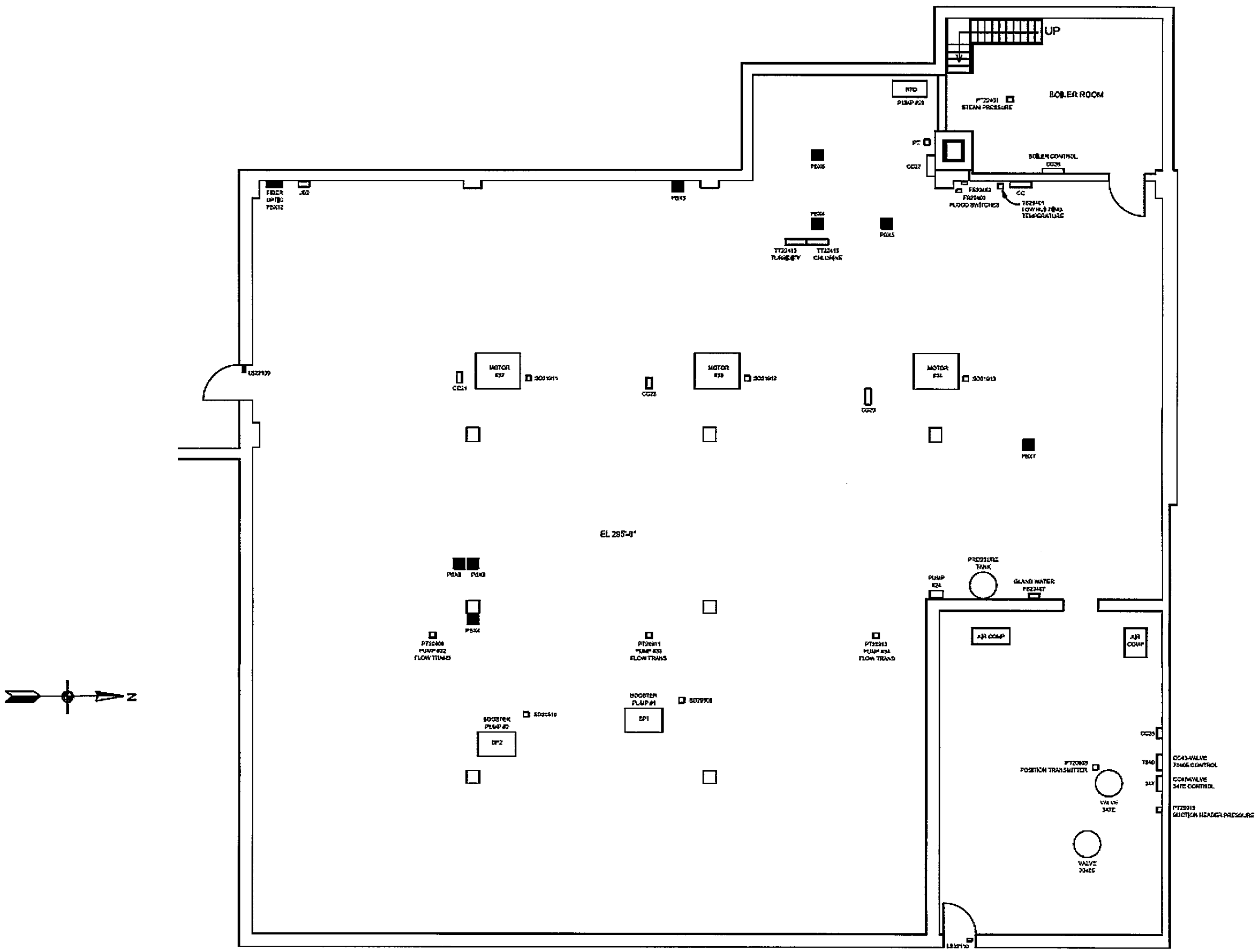
All screens should be confirmed accurate through the testing process. See **3.15 Testing Requirements.**

The developer will add a note to the top-right hand corner of each screen indicating the development status of each screen. The note will convey one of the following status:

Table 4-15 Screen Status Labels

Status Note	Definition
Development	This screen is in development and has not been fully tested.
Commissioned	This screen has been reviewed by Minneapolis Water for conformance to the standard. Before commissioning it must be successfully tested and proven by the systems integrator. Minneapolis Water will perform a final review and confirm that it is accurate and ready for operational use.

Appendix A



RECORD DRAWING
FIELD LOCATE UTILITIES
CALL GOPHER STATE
ONE CALL BEFORE
DIGGING

City of Minneapolis
Department of Public Works
Water Works Engineering

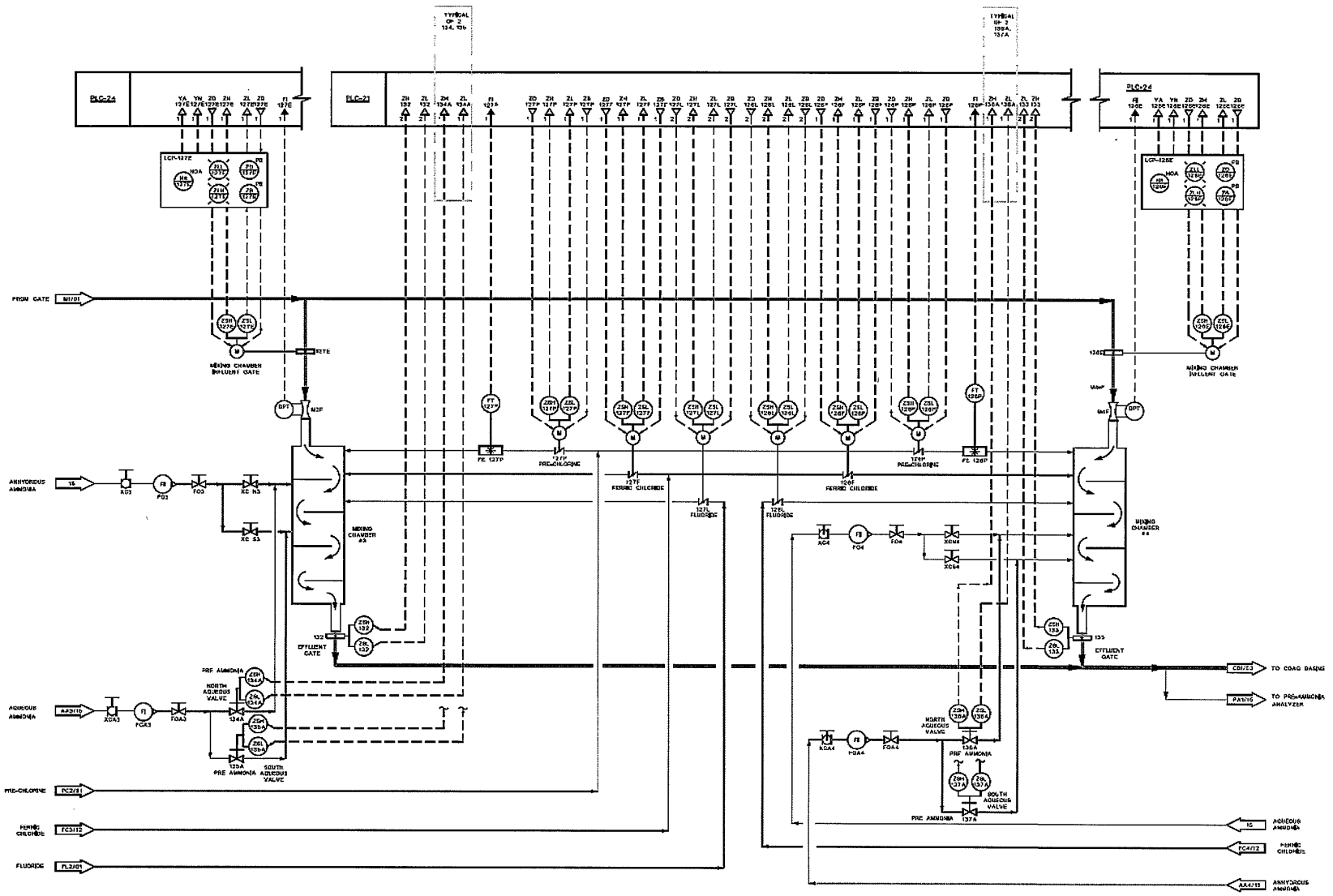
(PLANT/BLDG NAME)

FLOOR PLAN - PUMP FLOOR

DRAWN:
CHECKED:
DATE:
SCALE:

FEXXXXX-002

Appendix B



RECORD DRAWING

FIELD LOCATE UTILITIES
CALL GOPHER STATE
ONE CALL BEFORE
DIGGING
651-454-0002

City of Minneapolis
Department of Public Works
Water Works Engineering

(PLANT/BUILDING NAME)

MIXING CHAMBERS 3 & 4
PROCESS FLOW DIAGRAM

DRAWN:
CHECKED:
DATE:
SCALE:

FEXXXXX-002

Appendix C

(BUILDING/PLANT NAME)
PLC XX ELECTRICAL
DRAWING INDEX

ELECTRICAL DRAWINGS

DRAWING #	DESCRIPTION	COLUMN #
FEXXXXX-001	DRAWING INDEX SHEET	-
FEXXXXX-002	ASSEMBLY DRAWING	-
FEXXXXX-003	ASSEMBLY DRAWING	-
FEXXXXX-004	POWER DISTRIBUTION	1, 2, 3
FEXXXXX-200	DWP_05_EXAMPLE_RACK CONFIGURATION	200
FEXXXXX-201	DWP_05_I/O_EXAMPLE_SLOT 1, 2, 3	201, 202, 203
FEXXXXX-202	DWP_05_I/O_EXAMPLE_SLOT 4, 5	204, 205, 206
FEXXXXX-203	PLC I/O	207, 208, 209
FEXXXXX-204	PLC I/O	210, 211, 212
FEXXXXX-205	PLC I/O	213, 214, 215

NO.	DATE	DESCRIPTION	BY	CK	APP

NO.	DATE	DESCRIPTION	CK	CK	APP

RECORD DRAWING

FIELD LOCATE UTILITIES
CALL GOPHER STATE
ONE CALL BEFORE
DIGGING
651-454-0002

COLOR LEGEND

A	AMBER	G	GREEN	R	RED	STRIPED WIRE	
BK	BLACK	GY	GRAY	SHLD	SHIELD	SOLID COLOR + BASE STRIPE COLOR (AS SPECIFIED)	
BL	BLUE	O	ORANGE	V	VIOLET		
BR	BROWN	PK	PINK	W	WHITE		
CLR	CLEAR	PR	PURPLE	Y	YELLOW		

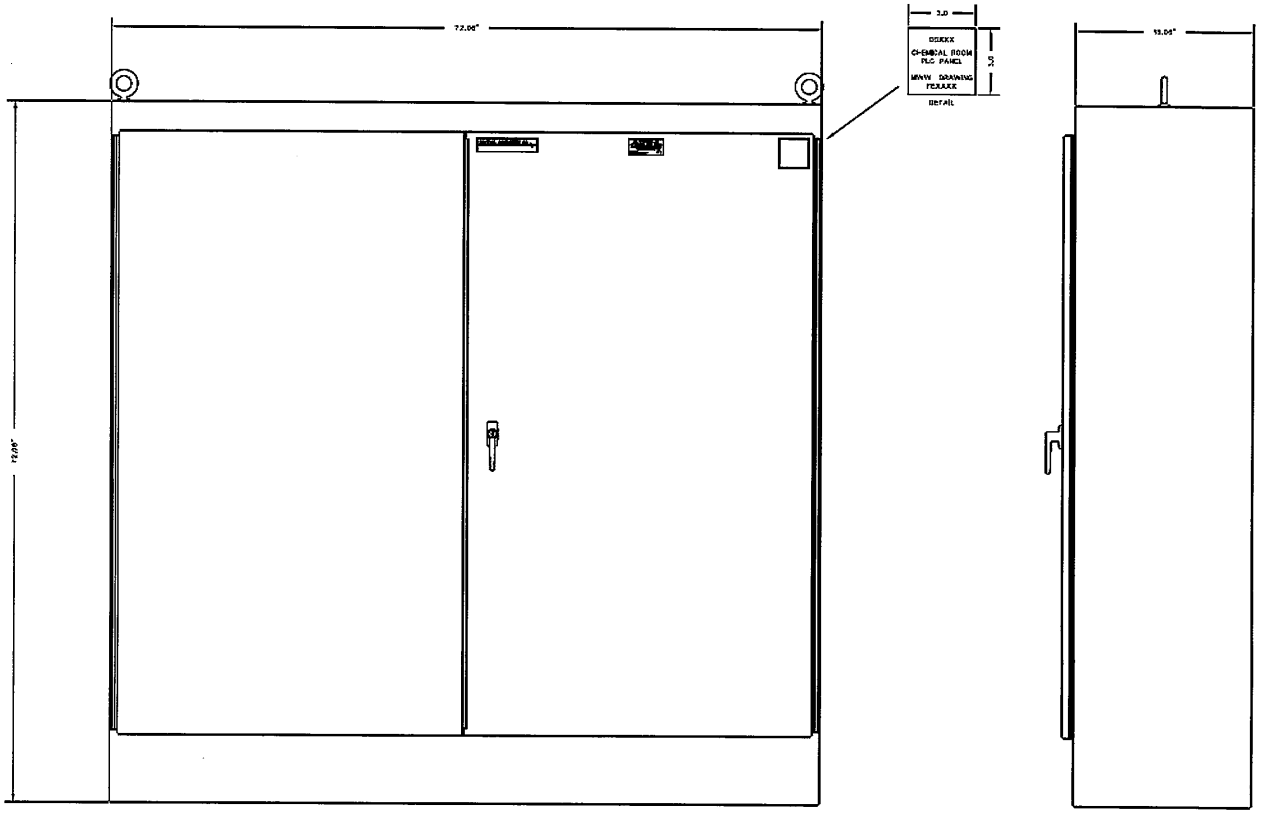
City of Minneapolis
Department of Public Works
Water Works Engineering

(BUILDING/PLANT NAME)

DRAWING INDEX SHEET

DRAWING:
CHECKED:
DATE:
SCALE:

FEXXXXX-001



DELTA PANEL
EXTERIOR - ANSI61 MEDIUM GRAY

FIELD LOCATE UTILITIES
CALL GOPHER STATE
ONE CALL BEFORE
DIGGING
651-454-0002

COLOR LEGEND

A	AMBER	G	GREEN	R	RED	STRIPED WIRE	
BK	BLACK	GY	GRAY	SHLD	SHIELD	SOLID COLOR FIRST, STRIPE COLOR LAST	
BL	BLUE	O	ORANGE	V	VIOLET		
BR	BROWN	PK	PINK	W	WHITE		
CLR	CLEAR	PR	PURPLE	Y	YELLOW		

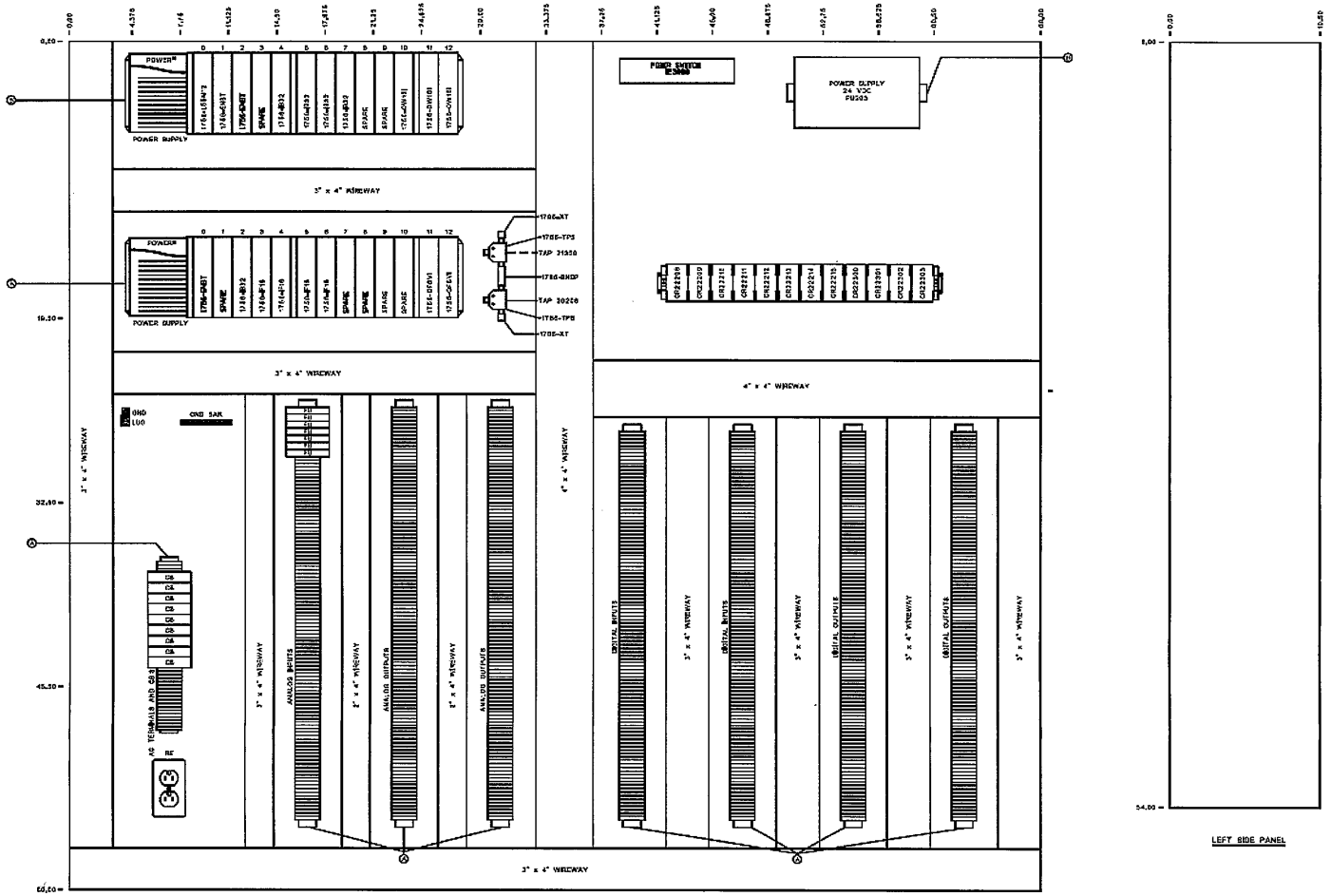
City of Minneapolis
Department of Public Works
Water Works Engineering

(PLANT/BUILDING NAME)

PLC-XX ASSEMBLY

DRAWN:
CHECKED:
DATE:
SCALE:

FEXXXXX-002



NOTES:

A. TYPE "A" CHANNEL 19MM DEEP MOUNTED ON 1" STAND OFFS

B. TYPE "B" CHANNEL 7.5MM DEEP

RECORD DRAWING

FIELD LOCATE UTILITIES
CALL GOPHER STATE
ONE CALL BEFORE
DIGGING
651-454-0002

COLOR LEGEND

A	AMBER	G	GREEN	R	RED	STRIPED WIRE: SOLID COLOR FIRST, STRIPE COLOR LAST	
BK	BLACK	GY	GRAY	SHLD	SHIELD		
BL	BLUE	O	ORANGE	V	VIOLET		
BR	BROWN	PK	PINK	W	WHITE		
CLR	CLEAR	PR	PURPLE	Y	YELLOW		

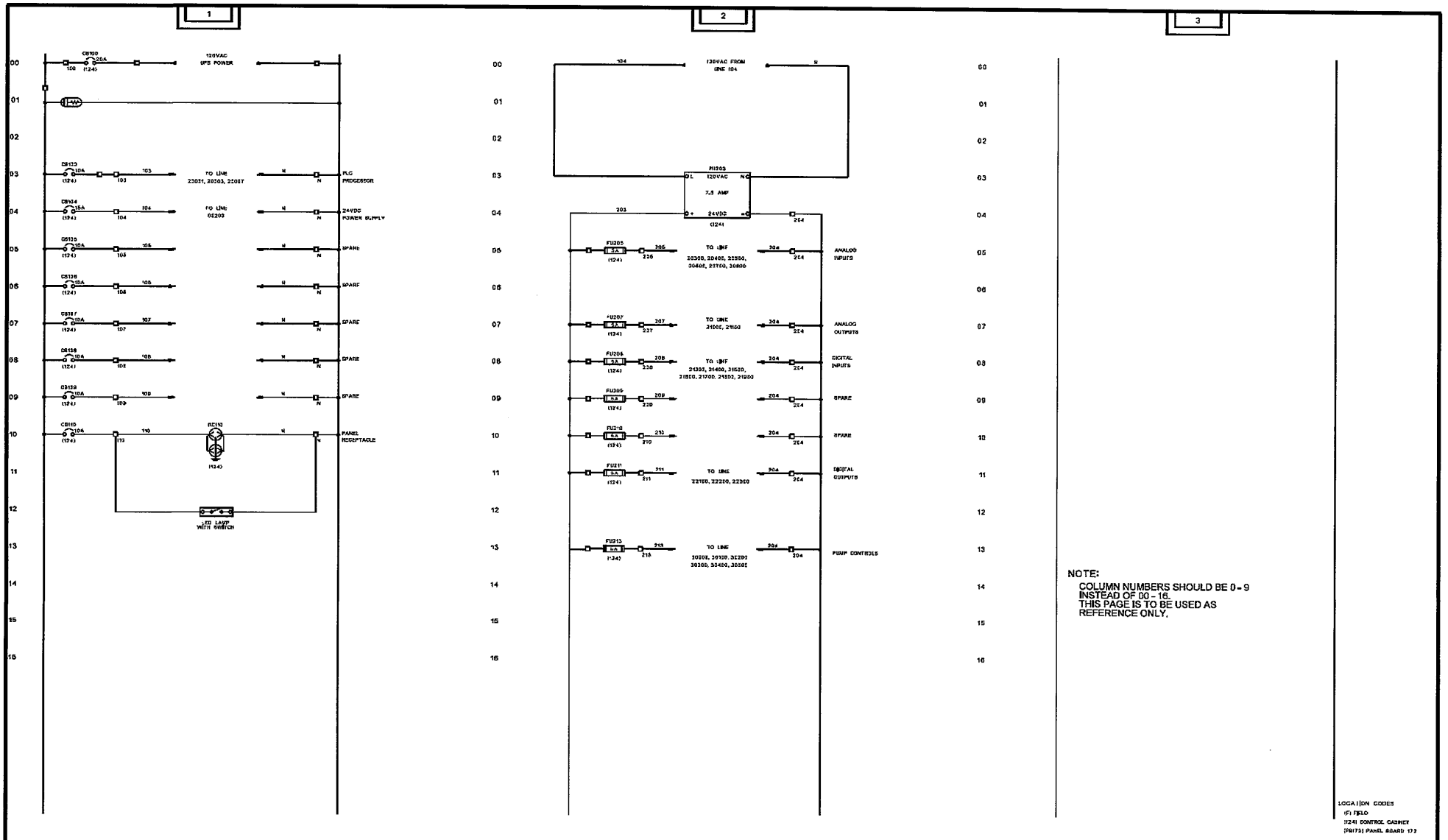
City of Minneapolis
Department of Public Works
Water Works Engineering

(PLANT/BUILDING NAME)

PCLXXX ASSEMBLY

DRAWING:
CHECKED:
DATE:
SCALE:

FEXXXXX-003



NOTE:
COLUMN NUMBERS SHOULD BE 0 - 9 INSTEAD OF 00 - 16.
THIS PAGE IS TO BE USED AS REFERENCE ONLY.

LOCATION CODES
(F) FIELD
(124) CONTROL CABINET
(PB172) PANEL BOARD 172

RECORD DRAWING
FIELD LOCATE UTILITIES
CALL GOPHER STATE
ONE CALL BEFORE
DIGGING
651-454-0002

COLOR LEGEND

A	AMBER	G	GREEN	R	RED	STRIPED WIRE: GOLD COLOR FIRST, STRIPE COLOR LAST	
BK	BLACK	GY	GRAY	SHLD	SHIELD		
BL	BLUE	O	ORANGE	V	VIOLET		
BR	BROWN	PK	PINK	W	WHITE		
CLR	CLEAR	PR	PURPLE	Y	YELLOW		

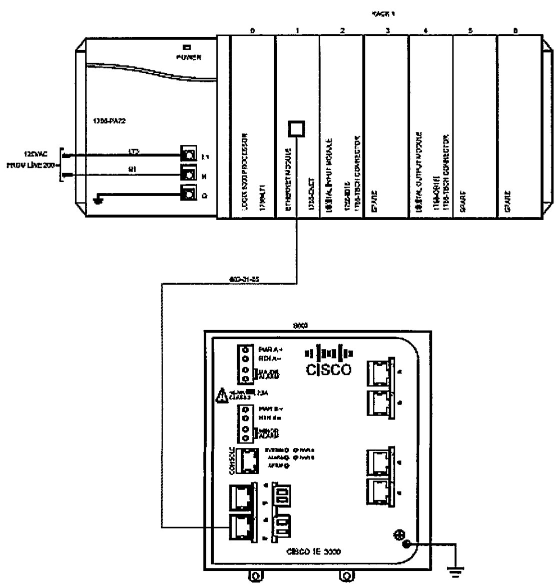
City of Minneapolis
Department of Public Works
Water Works Engineering

(PLANT/BUILDING NAME)

PLC-XXX POWER DISTRIBUTION

DRAWN:
CHECKED:
DATE:
SCALE:
FEXXXXX-004

NO.	DATE	DESCRIPTION	DR	CK	APP
NO.	DATE	DESCRIPTION	DR	CK	APP



REV	DATE	DESCRIPTION	DR	CK	APP	REV	DATE	DESCRIPTION	DR	CK	APP

RECORD DRAWING

FIELD LOCATE UTILITIES
CALL GOPHER STATE
ONE CALL BEFORE
DIGGING
651-454-0002

COLOR LEGEND

A	AMBER	G	GREEN	R	RED
BK	BLACK	GY	GRAY	SHLD	SHIELD
BL	BLUE	O	ORANGE	V	VIOLET
BN	BROWN	PK	PINK	W	WHITE
CLR	CLEAR	PR	PURPLE	Y	YELLOW

STRIPED WIRE
SOLID COLOR FIRST,
STRIPE COLOR LAST

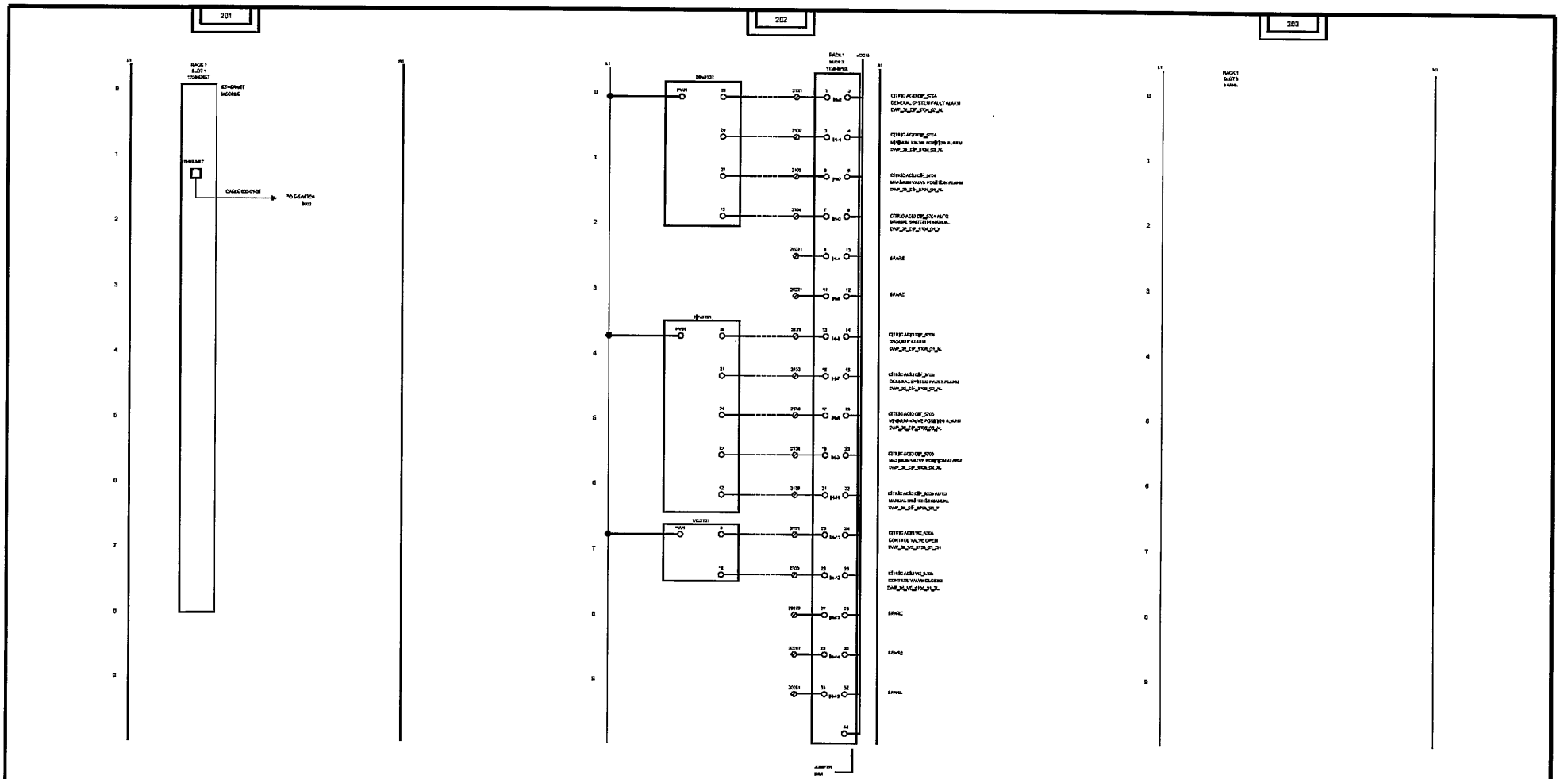
City of Minneapolis
Department of Public Works
Water Works Engineering

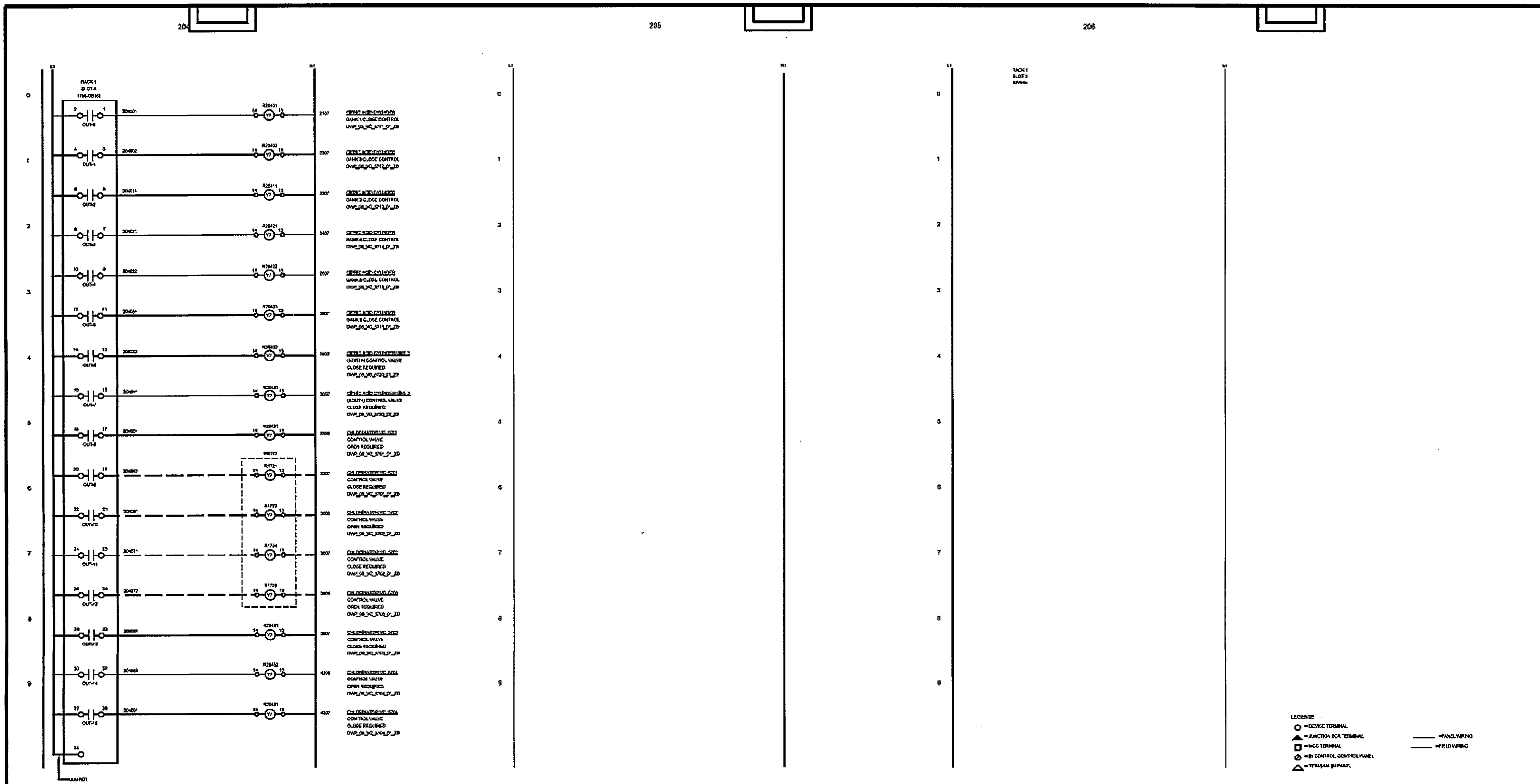
(PLANT/BUILDING NAME)

DWP_05_EXAMPLE_RACK CONFIGURATION

DRAWN:
CHECKED:
DATE:
SCALE:

FEXXXXX-200


201
202
203
RECORD DRAWING
FIELD LOCATE UTILITIES
CALL GOPHER STATE
ONE CALL BEFORE
DIGGING
651-454-0002
City of Minneapolis
Department of Public Works
Water Works Engineering
EXAMPLE SCHEMATIC
DWP_05_I/O_EXAMPLE_1, 2, 3
DRAWN
CHECKED
DATE
SCALE
FEXXXXX-201



SUBMITTAL COPY - NOT INTENDED FOR INSTALLATION - AS BUILTS WILL BE PROVIDED AT SHIPMENT

RECORD DRAWING

FIELD LOCATE UTILITIES
CALL GOPHER STATE
ONE CALL BEFORE
DIGGING
651-454-0002

City of Minneapolis
Department of Public Works
Water Works Engineering

EXAMPLE SCHEMATIC

DWP_05_I/O_EXAMPLE_4, 5

DRAWN:
CHECKED:
DATE:
SCALE:

FEXXXXX-202

Appendix D

RESPONSIBLE ORGANIZATION	RTD/THERMOCOUPLE TEMPERATURE TRANSMITTER OR SWITCH Device Specification	SPECIFICATION IDENTIFICATIONS	
CDM Constructors		Document no	
25 Industrial Ave		Latest revision	Date 9/20/11
Chelmsford, MA		Issue status	
01824			

TRANSMITTER OR SWITCH		PERFORMANCE CHARACTERISTICS				
Housing type	Nema 4X	Accuracy rating				
Input sensor type	Thermocouple type B	Measurement LRL	-50 C	URL	662 F	
Output signal type	analog current	Min ambient working temp	-4 F	Max	185 F	
Min measurement span	Max	Contacts ac rating		At max		
Temp coef/Tolerance cl		Contacts dc rating		At max		
Isolation type						
Enclosure type no/class						
Adjustment type						
Characteristic curve						
Digital communication std						
Signal power source	Loop Powered					
Measurement type						
Configuration-no of wires						
Contacts arrangement	Quantity					
Failsafe style						
Transient protection						
Integral indicator style						
Signal termination type						
Cert/Approval type	FM Explosion Proof					
Mounting type	Pipe Clamp					
Failure/Diagnostic action						
Dead band type						
Switch time delay						
Temp compensation type						
Enclosure material						
Mounting kit material						
Display	LCD					

ACCESSORIES	
Remote indicator style	
Indicator enclosure	
Air set filter style	
Air set gauges	

SPECIAL REQUIREMENTS	
Custom tag	
Reference specification	
Compliance standard	
Calibration report	
Software configuration	

PHYSICAL DATA	
Estimated weight	4.73 oz
Overall height	
Removal clearance	
Signal conn nominal size	Style
Mfr reference dwg	

CALIBRATIONS AND TEST		INPUT OR SETPOINT			OUTPUT OR SCALE	
TAG NO/FUNCTIONAL IDENT	MEAS/SIGNAL/TEST	LRV	URV	ACTION	LRV	URV
TE/TIT-9231	Temp- Analog output 1	0 F	300 F	Direct	4 mA	20 mA
	Temp-Analog output 2					
	Temp-Scale					
	Temp diff-Digital output					
	Temp-Digital output					
	Termn temp-Digital output					
	Temp setpoint 1-Output					
	Temp setpoint 2-Output					
	Temp setpoint 3-Output					
	Temp setpoint 4-Output					

COMPONENT IDENTIFICATIONS		
COMPONENT TYPE	MANUFACTURER	MODEL NUMBER
Transmitter	Rosemount	644HANAM5J8Q4
RTD Sensor	Rosemount	RTD-R-2237

Rev	Date	Revision Description	By	Appv1	Appv2	Appv3	REMARKS

Form: 20T2221 Rev 0

RESPONSIBLE ORGANIZATION	ELECTRONIC WEIGHT TRANSMITTER	SPECIFICATION IDENTIFICATIONS	
CDM Constructors	INDICATOR OR CONTROLLER	Document no	
25 Industrial Ave	Device Specification	Latest revision	Date 9/19/11
Chelmsford, MA		Issue status	
01824			

OPERATING PARAMETERS		PERFORMANCE CHARACTERISTICS	
Project number	Sub project no	Linearity	Ref
Project	Canoe Brook WTP	Repeatability	Ref
Enterprise		Max input signal	
Site		Max Resolution	
Area	Cell / Unit	Sensitivity	Ref
Related equipment		Max response time	
Service		Min ambient working temp	Max
		Contacts ac rating	At max
P&ID/Reference dwg number		Contacts dc rating	At max
Remote hazardous area cl	Div/Zone / Group	Max sensor to receiver lg	
Remote area min ign temp	Temp ident number		

TRANSMITTER OR INDICATOR OR CONTROLLER		ACCESSORIES	
Housing type	Panel Mount	Remote indicator style	
Interface style	Analog Current	Remote indicator mounting	
Input sensor/signal type		Remote indicator enclosure	
Input excitation style	10 VDC	Calibrator style	
Output signal type	analog current		
Analog output resolution			
Enclosure type no/class	NA		
Control mode	Programmable		
Local operator interface	Push Button	SPECIAL REQUIREMENTS	
Characteristic curve		Custom tag	Lamacoid Label on panel
Digital communication std		Reference specification	
Signal power source	115 V (ac) 50/60 Hz	Compliance standard	
Aux input signal type		Software configuration	
Max qty sensor/xdcr/xmtr	1	Software program	
Signal summing circuit			
Contacts arrangement	Quantity		
Integral indicator style			
Display resolution	10,000 counts	PHYSICAL DATA	
Cert/Approval type	NTEP, UL	Estimated weight	
Mounting location/type	Panel mount	Overall width	9.73"
Failure/Diagnostic action		Overall height	6.99"
Transducer diagnostics		Overall depth	7.11"
Signal filtration		Signal conn nominal size	Style
Transducer calibration		Mfr reference dwg	
Enclosure material			

CALIBRATIONS AND TEST		INPUT OR TEST			OUTPUT OR SCALE	
TAG NO/FUNCTIONAL IDENT	MEAS/SIGNAL/SCALE	LRV	URV	ACTION	LRV	URV
WIT-9220	Weight-Analog output 1	0	2,500	Direct	4 mA	20 Ma
	Weight-Analog output 2					
	Weight-Digital output					
	Weight-Scale 1					
	Weight-Scale 2					
	Weight setpoint 1-Output					
	Weight setpoint 2-Output					
	Weight setpoint 3-Output					
	Weight setpoint 4-Output					
	Weight setpoint 5-Output					
	Weight setpoint 6-Output					
	Weight setpoint 7-Output					
	Weight setpoint 8-Output					
	Failure signal-Output					

COMPONENT IDENTIFICATIONS		
COMPONENT TYPE	MANUFACTURER	MODEL NUMBER
Transmitter	Fairbanks	5200A P/N 21227

Rev	Date	Revision Description	By	Appv1	Appv2	Appv3	REMARKS

Form: 20W2221 Rev 0

RESPONSIBLE ORGANIZATION	LOAD CELL OR TRANSDUCER	SPECIFICATION IDENTIFICATIONS	
CDM Constructors 25 Industrial Ave Chelmsford, MA 01824	Device Specification	Document no	
		Latest revision	Date 9/19/11
		Issue status	

BODY OR HOUSING	
Body/Housing type	
Construction style	
Load conn/thru-hole size	
Load conn termn type	Style
Load button	
Body/Housing material	
Seal/O ring material	

SENSING ELEMENT	
Force sensor type	compression only
Construction style	
Rated capacity/stress	5,000 Lbs
Rated nominal output	
Nominal resistance	350 ohms

SIGNAL OR AMPLIFIER	
Configuration type	
Output signal type	
Enclosure type no/class	
Local adjustment type	
Signal termination type	
Supply/Excitation voltage	5 - 15 VDC
Cert/Approval type	FM, NTEP
Mounting location/type	
Remote enclosure material	

LEAD WIRE AND EXTENSION	
Extension type	
Conductor nominal size	
Cable length	25'
Connector configuration	
Signal termination type	Bare wire
Cable jacket material	

MOUNTING HARDWARE	
Hardware type	
Construction style	
Surface finish	
Hardware material	
Isolation pad material	

SUMMING UNIT OR JUNCTION BOX	
Configuration type	
Enclosure type no/class	
Max input signal quantity	1
Cert/Approval type	
Mounting location/type	
Enclosure material	

PERFORMANCE CHARACTERISTICS		
Min working temperature		Max
Accuracy rating		Ref
Linearity		Ref
Repeatability		Ref
Temp compensation LRL		URL
Overrange limit		Ref
Temp effect on zero		Ref
Temp effect on span		Ref
Life cycles		

ACCESSORIES	
Simulated component	
Mating connector	
Access ramp	
Pit frame	

SPECIAL REQUIREMENTS	
Custom tag	
Reference specification	
Compliance standard	
Calibration report	

PHYSICAL DATA		
Estimated weight		
Overall length	36"	
Overall height	3"	
Outside diameter/Width	36"	
Signal conn nominal size		Style
Mfr reference dwg		

CALIBRATIONS AND TEST		INPUT OR TEST			OUTPUT	
TAG NO/FUNCTIONAL IDENT	MEAS/SIGNAL/SCALE	LRV	URV		LRV	URV
WE-9220	Weight 1-Output signal	0	2,500 Lbs		0 mV	45 mV
	Weight 2-Output signal					
	Weight 3-Output signal					
	Weight 4-Output signal					
	Weight 5-Output signal					
	Weight 6-Output signal					
	Weight 7-Output signal					
	Weight 8-Output signal					
	Weight sum-Output signal					

COMPONENT IDENTIFICATIONS		
COMPONENT TYPE	MANUFACTURER	MODEL NUMBER
Floor Scale	Fairbanks	Aegis 3400 Mild Steel Floor Scale

Rev	Date	Revision Description	By	Appv1	Appv2	Appv3	REMARKS

Form: 20W2211 Rev 0

RESPONSIBLE ORGANIZATION	PRESSURE GAUGE	SPECIFICATION IDENTIFICATIONS	
CDM Constructors 25 Industrial Ave Chelmsford, Ma 01824	Device Specification	Document no	
		Latest revision	Date 9/22/11
		Issue status	

OPERATING PARAMETERS		
Project number	Sub project no	
Project		
Enterprise		
Site		
Area	Cell	Unit
Related equipment		
Service		
P&ID/Reference dwg number		
Material name		
Minimum pressure	0 PSI	
Normal pressure		
Maximum pressure	30 PSI	
Normal temperature		
Maximum temperature		
Material phase		

PRCCESS CONNECTION AND CASE		
Case type		
Case style	Liquid Filled	
Gauge size	100 mm (4")	
Process conn nominal size	1/2"	Style NPT
Process conn location	Bottom	
Case pressure relief type		
Ring style		
Mounting type	Stem mounted	
Case material	304 SS	
Ring material	304 SS	
Exterior treatment-color		
Window material	Polycarbonate	
Stem material	316L SS	
Gasket/O ring material		
Liquid fill material	glycerin	

PRESSURE ELEMENT AND MOVEMENT	
Elastic element type	C-Type bourdon tube
Movement style	
Nominal accuracy grade	2% full scale
Joint type	
Element material	316L SS
Movement material	

DIAL AND POINTER	
Dial scale type	Single
Pointer adjustment	Non-adjustable
Graduations and color	Black
Scale range type	
Dial material	Black aluminum

SIPHON		
Siphon type		
End conn nominal size		Style
Overall length		
Siphon material		

PERFORMANCE CHARACTERISTICS		
Max press at design temp		At
Min working temperature		Max
Min ambient working temp	20 F	Max 150 F

ACCESSORIES
Pressure limit valve matl
Restrictor style
Pressure snubber matl
Pulsation dampener matl
Signal-Isolator Material

SPECIAL REQUIREMENTS
Custom tag
Reference specification
Special preparation
Compliance standard
Service design

PHYSICAL DATA
Estimated weight
Maximum thickness
Max case outside dia
Mfr reference dwg

CALIBRATIONS AND TEST		SCALE	
TAG NO/FUNCTIONAL IDENT	PRESSURE OR SCALE	LRV	URV
PI-3001-1,2,3	Pressure/Scale 1	0 PSI	30 PSI
	Pressure/Scale 2		

COMPONENT IDENTIFICATIONS		
COMPONENT TYPE	MANUFACTURER	MODEL NUMBER
Pressure Gauge	Ashcroft	10 1008 SL 04 030#

Rev	Date	Revision Description	By	Appv1	Appv2	Appv3	REMARKS

Form: 20P2001 Rev 0

RESPONSIBLE ORGANIZATION	PRESSURE SWITCH w/wo TRANSMITTER Device Specification	SPECIFICATION IDENTIFICATIONS
CDM Constructors 25 Industrial Ave Chelmsford, MA 01824		Document no Latest revision Date 9/22/11 Issue status

SWITCH BODY			
Body type	Mfr standard		
Process conn nominal size	1/2"	Rating	
Process conn termn type	Threaded	Style	FNPT
Body material	Aluminum		
Seal/O ring material	Viton		

SENSING ELEMENT		
Sensor element type	Diaphragm	
Adjustable LRL		URL
Diaphragm/Wetted material		

SWITCH MECHANISM w/wo TRANSMITTER			
Housing type			
Element Style			
Output signal type	Dry Contact		
Enclosure type no/class	Nema 4X		
Reset style			
Set point Adjustment type	Single		
Signal power source			
Measurement type			
Contacts arrangement	SPDT	Quantity	1
Failsafe style			
Integral indicator style			
Signal termination type	Screw terminals		
Cert/Approval type	UL/CSA		
Mounting type			
Dead band type	Fixed		
Enclosure material			
Exterior treatment matl			

PERFORMANCE CHARACTERISTICS			
Max press at design temp		At	
Min working temperature		Max	
Output accuracy rating			
Repeatability			
Press Lower Range-limit	2 PSI	URL	15 PSI
Max overrange limit			
Dead band rating	1.0 - 2.5		
Min ambient working temp		Max	
Contacts ac rating	11A	At max	125/250
Contacts dc rating	5A	At max	30
Proof PSI	500 PSI		
Minimum Burst PSI	1500 PSI		

ACCESSORIES	
Sealed leads adapter	
Breather/Drain style	

SPECIAL REQUIREMENTS	
Custom tag	SST Tag or Equivalent
Reference specification	
Special preparation	
Compliance standard	

PHYSICAL DATA			
Estimated weight			
Overall height			
Removal clearance			
Signal conn nominal size		Style	
Mfr reference dwg			

CALIBRATIONS AND TEST		INPUT/SETPOINT/TEST			OUTPUT OR SCALE	
TAG NO/FUNCTIONAL IDENT	MEAS/SIGNAL/TEST	LRV	URV	ACTION	LRV	URV
PSL-1020	Press setpoint 1-Output	5 PSI				
	Press setpoint 2-Output					
	Pressure-Analog output					
	Pressure-Scale					

COMPONENT IDENTIFICATIONS		
COMPONENT TYPE	MANUFACTURER	MODEL NUMBER
Pressure Switch	Ashcroft	LPSN4JV07XFSXNH

Rev	Date	Revision Description	By	Appv1	Appv2	Appv3	REMARKS

Form: 20P2401 Rev 0

RESPONSIBLE ORGANIZATION		PRESSURE TRANSMITTER	SPECIFICATION IDENTIFICATIONS	
CDM Constructors			Document no	
25 Industrial Ave		Device Specification	Latest revision	Date 9/22/11
Chelmsford, MA			Issue status	
01824				

TRANSMITTER BODY				
Body/Flange type	Coplanar			
Process conn nominal size	1/2"	Rating		
Process conn termn type	Threaded	Style	NPT (F)	
Vent/Drain location	Side			
Mounting type	2 in pipe,angle bracket			
Body/Flange material	316 SST			
Vent/Drain material	316SST			
Bolting material	300 SST			
Flange adapter material				
Gasket/O ring material	Glass Filled PTFE			
Mounting kit material	SST			

SENSING ELEMENT			
Detector type			
Min pressure span	3 PSI	Max	300 PSI
Diaphragm/Wetted material	316L SST		
Fill fluid material	Silicone		

TRANSMITTER	
Output signal type	Analog current
Enclosure type no/class	NEMA 4X
Characteristic curve	
Digital communication std	HART Protocol
Signal power source	Loop
Transient protection	NA
Integral indicator style	LCD
Signal termination type	Terminal Strip
Cert/Approval type	FM Explosion proof
Span-Zero adjust lct	
Failure/Diagnostic action	
Enclosure material	Aluminum

PERFORMANCE CHARACTERISTICS				
Max press at design temp	3626 psig	At		
Min working temperature	-40 F	Max	300 F	
Accuracy rating				
Pressure LRL	-300 PSI	URL	300 PSI	
Min ambient working temp	-40 F	Max	175 F	

ACCESSORIES	
Air set filter style	
Air set gauges	
Heating kit style	
Remote indicator style	
Manifold valve style	5 Valve

SPECIAL REQUIREMENTS	
Custom tag	SST Tag
Reference specification	
Special preparation	
Compliance standard	
Software configuration	

PHYSICAL DATA			
Estimated weight	13 Lbs		
Overall height	9.88 Inches		
Removal clearance			
Signal conn nominal size		Style	
Mfr reference dwg			

CALIBRATIONS AND TEST		INPUT			OUTPUT OR SCALE	
TAG NO/FUNCTIONAL IDENT	MEAS/SIGNAL/TEST	LRV	URV	ACTION	LRV	URV
PIT-2510-1, 2, 3	Pressure-Analog output	0 PSIG	200 PSIG	Direct	4 mA	20 mA
	Pressure-Scale					
	Pressure-Digital output					
	Temp-Digital output					

COMPONENT IDENTIFICATIONS		
COMPONENT TYPE	MANUFACTURER	MODEL NUMBER
Transmitter	Rosemount	3051CG4A02A1AS5B4E5M5Q4
Manifold	Rosemount	0305RC22B11B4

Rev	Date	Revision Description	By	Appv1	Appv2	Appv3	REMARKS

Form: 20P2201 Rev 0

1	RESPONSIBLE ORGANIZATION		NON-CONTACT ULTRASONIC LEVEL TRANSMITTER w/wo SWITCHES Device Specification		6	SPECIFICATION IDENTIFICATIONS	
2		CDM Constructors			7	Document no	
3		25 Industrial Ave			8	Latest revision	Date
4		Chelmsford, MA			9	Issue status	
5					10		

11	PROCESS CONNECTION				60	PERFORMANCE CHARACTERISTICS			
12	Body/Fitting type	Threaded Probe			61	Max press at design temp	30 psi	At	
13	Process conn nominal size	2"	Rating		62	Min working temperature	-7 F	Max	140 F
14	Process conn termn type	Threaded	Style	NPT	63	Accuracy rating	+/- .02%		
15	Wetted material	PVDF			64	Level lower range limit	4"	URL	9.8'
16	Flange material				65	Min measurement span		Max	
17	Seal/O ring material	Viton			66	Beam angle			
18					67	Min ambient working temp	-40 F	Max	160 F
19					68	Contacts ac rating		At max	
20					69	Contacts dc rating		At max	
21	SENSING ELEMENT				70	Max sensor to receiver lg			
22	Detector type	Ultra Sonic			71	Beam Width	3"		
23	Detector style				72				
24	Insertion length	2.7"			73				
25	Integral cable length				74				
26					75				
27					76				
28					77				
29	CONNECTION HEAD				78				
30	Type				79				
31	Enclosure type no/class	NEMA 4X			80				
32	Cert/Approval type	CE, RoHS			81				
33	Mounting location/type				82				
34	Enclosure material	Polycarbonate			83				
35					84	ACCESSORIES			
36					85	Connecting cables length			
37					86	Enclosure heater			
38	TRANSMITTER w/wo SWITCHES				87	Mounting hardware			
39	Housing type	1/8 DIN			88				
40	Measurement compensation				89				
41	Output signal type	analog current & relays			90				
42	Enclosure type no/class	NEMA 4X			91				
43	Control sequence				92	SPECIAL REQUIREMENTS			
44	Characteristic curve				93	Custom tag			
45	Digital communication std				94	Reference specification			
46	Signal power source	Line 120 VAC			95	Compliance standard			
47	Contact arrangement	SPDT	Quantity	2	96	Calibration report			
48	Failsafe style				97				
49	Integral indicator style	4 Digit LCD			98				
50	Cert/Approval type				99				
51	Mounting location/type	Panel mount			100	PHYSICAL DATA			
52	Failure/Diagnostic action				101	Estimated weight			
53	Signal processing				102	Overall height			
54	Enclosure material	Polycarbonate			103	Removal clearance			
55					104	Signal conn nominal size		Style	
56					105	Mfr reference dwg			
57					106				
58					107				
59					108				

110	CALIBRATIONS AND TEST		INPUT OR SETPOINT			OUTPUT OR SCALE	
111	TAG NO/FUNCTIONAL IDENT	MEAS/SIGNAL/TEST	LRV	URV	ACTION	LRV	URV
112	LE/LIT-9001	Level--Analog output	0	16'	Direct	4 mA	20 mA
113		Level-Scale					
114		Level setpoint 1-Output					
115		Level setpoint 2-Output					
116		Level setpoint 3-Output					
117							

118	COMPONENT IDENTIFICATIONS		
119	COMPONENT TYPE	MANUFACTURER	MODEL NUMBER
120	Sensor	Flowline	LU81-51-01
121	Display	Flowline	L151-1001
122			
123			
124			
125			

Rev	Date	Revision Description	By	Appv1	Appv2	Appv3	REMARKS

Form: 20L2171 Rev 0

RESPONSIBLE ORGANIZATION	FLOAT OR DISPLACER LEVEL SWITCH	SPECIFICATION IDENTIFICATIONS	
CDM Constructors 25 Industrial Ave Chelmsford, MA 01824	Device Specification	Document no	
		Latest revision	Date 8/29/11
		Issue status	

BODY OR CAGE		
Body/Cage type		
Process conn nominal size		Rating
Process conn termn type		Style
Flange facing finish		
Lower conn location		Upper
Gage glass conn nom size		Style
Try-cock conn nom size		Style
Head orientation/type		
Extension/Heat insulator		
Body/Cage material		
Bolting material		
Gasket material		

SENSING ELEMENT		
Sensor type	Float	
Sp gr Lower Range-Limit		URL
Adjustable LRL		URL
Sensor quantity		
Float/Displacer dia	5.5"	Length
Extension/stem length		
Float/Displacer material	304SS	
Torque tube/Spring matl		
Magnetic sleeve material		
Extension/Cable material	CPE	
Trim material		
Cable Length	60 ft	

SWITCH MECHANISM		
Housing type		
Element style	Hermetically Sealed	
Output signal type	Reed relay	
Enclosure type no/class		
Control sequence	High and High, Failsafe	
Signal power source		
Contacts arrangement	SPST	Quantity 1
Signal termination type	Exposed Wire	
Cert/Approval type		
Dead band type		
Enclosure material		
Exterior coating material		

PERFORMANCE CHARACTERISTICS		
Max press at design temp		At
Min working temperature	-31 F	Max 194 F
Repeatability		
Level Lower Range-Limit		URL
Dead band rating		
Min ambient working temp		Max
Contacts ac rating	100VA	At max
Contacts dc rating		At max

ACCESSORIES
Try-cocks style
Gage glass style
Gage valve style
Mechanical test mechanism

SPECIAL REQUIREMENTS
Custom tag
Reference specification
Special preparation
Compliance standard
Construction code

PHYSICAL DATA		
Estimated weight		
Overall height		
Removal clearance		
Upper to lower conn lg		
Lower to drain conn lg		
Signal conn nominal size		Style
Mfr reference dwg		

CALIBRATIONS AND TEST		SETPOINT		OUTPUT	
TAG NO/FUNCTIONAL IDENT	MEAS/SIGNAL/TEST	LRV	URV	ACTION	LRV	URV
LSHH-2503	Level setpoint 1-Output	7" From bottom		NC	24 VDC	
	Level setpoint 2-Output					
	Level setpoint 3-Output					
	Level setpoint 4-Output					

COMPONENT IDENTIFICATIONS		
COMPONENT TYPE	MANUFACTURER	MODEL NUMBER
Float	Siemens/US Filter	W2T294166
Pipe Clamp Assy	Siemens/US Filter	W2T294057

Rev	Date	Revision Description	By	Appv1	Appv2	Appv3	REMARKS

Form: 20L2311 Rev 0

RESPONSIBLE ORGANIZATION	CAPACITANCE OR RF ADMITTANCE LEVEL SWITCH Device Specification	SPECIFICATION IDENTIFICATIONS
CDN Constructors 25 Industrial Ave Chelmsford, MA 01824		Document no Latest revision Date Issue status

PROCESS CONNECTION				
Body/Fitting type				
Process conn nominal size	1 1/2"	Rating		
Process conn termn type	Threaded	Style	NPT	
Wetted material				
Flange material				
Seal/O ring material				

SENSING ELEMENT	
Configuration type	Fully insulated Rod
Number of elements	1
Probe diameter	
Insertion length	19.69"
Inactive/Dead length	
Integral cable length	
Probe material	316L SST
Insulation/Sheath matl	PVDF
Weight material	
O-Ring	FKM

CONNECTION HEAD OR PREAMPLIFIER	
Type	
Measurement compensation	
Input signal URL	
Output signal type	
Enclosure type no/class	NEMA 4X/IP65
Signal power source	115 VAC
Cert/Approval type	CSA, FM
Mounting location/type	Bracket
Enclosure material	Epoxy coated aluminum

SWITCH MECHANISM			
Housing type			
Element style			
Measurement compensation			
Output signal type	Relay		
Input signal LRL		URL	
Enclosure type no/class			
Signal power source			
Dead band type			
Contacts arrangement	SPDT form C	Quantity	1
Failsafe style	Selectable low		
Integral indicator style	LEDs (3)		
Cert/Approval type			
Mounting location/type			
Static discharge prot			
Failure/Diagnostic action			

SWITCH MECHANISM Continued			
RFI protection			
Switch time delay			
Enclosure material			

PERFORMANCE CHARACTERISTICS			
Max press at design temp		At	
Min working temperature	-40 F	Max	185 F
Max discharge to sensor			
Repeatability/Sensitivity			
Min measurement span		Max	
Min ambient working temp	-40 F	Max	185 F
Contacts ac rating	8A	At max	250 VAC
Contacts dc rating	5A	At max	30 VDC
Max sensor to receiver lg			

ACCESSORIES	
Connecting cables length	
Mounting hardware	
External relay	
Intrinsic safety barrier	

SPECIAL REQUIREMENTS	
Custom tag	
Reference specification	
Compliance standard	

PHYSICAL DATA			
Estimated weight			
Overall height			
Removal clearance			
Signal conn nominal size		Style	
Mfr reference dwg			

CALIBRATIONS AND TEST		SETPOINT			OUTPUT	
TAG NO/FUNCTIONAL IDENT	MEAS/SIGNAL/TEST	LRV	URV	ACTION	LRV	URV
LSH-4505-1, 2	Level setpoint 1-Output	1" from bottom		NC	24 VDC	
	Level setpoint 2-Output					
	Level setpoint 3-Output					
	Level setpoint 4-Output					

COMPONENT IDENTIFICATIONS		
COMPONENT TYPE	MANUFACTURER	MODEL NUMBER
Point Level Switch	Siemens	7ML5630-0DD0D1HAY15
Mounting Bracket	Siemens	A5E01163685

Rev	Date	Revision Description	By	Appv1	Appv2	Appv3	REMARKS

Form: 201.2301 Rev 0

RESPONSIBLE ORGANIZATION		DIFFERENTIAL PRESSURE TRANSMITTER Device Specification	SPECIFICATION IDENTIFICATIONS		
CDM Constructors			Document no		
25 Industrial Ave			Latest revision	A	Date 7/22/11
Chelmsford			Issue status		
01824					

TRANSMITTER BODY			
Body/Flange type	Co-planar		
Process conn nominal size	1/2"	Rating	
Process conn termn type	Threaded	Style	FNPT
Vent/Drain location	Side		
Mounting type	2" SST Mounting Bracket		
Body/Flange material	316 SST		
Vent/Drain material	316 SST		
Bolting material	300 SST Bolts		
Flange adapter material			
Gasket/O ring material	Glass Filled PTFE		
Mounting kit material	SST		

SENSING ELEMENT			
Detector type			
Min diff press span	-250" H2O	Max	250" H2O
Diaphragm/Wetted material	316L SST		
Fill fluid material	Silicone		

TRANSMITTER	
Output signal type	Analog Current
Enclosure type no/class	Nema 4X
Characteristic curve	
Digital communication std	HART
Signal power source	
Transient protection	NA
Integral indicator style	LCD
Signal termination type	Integral
Cert/Approval type	FM Explosion Proof
Span-Zero adjust lct	
Failure/Diagnostic action	Selectable
Enclosure material	low copper-aluminum

PERFORMANCE CHARACTERISTICS			
Max press at design temp	6092 psi	At	200 F
Min working temperature	-40 F	Max	300 F
Accuracy rating	.04%		
Diff pressure LRL	-250" H2O	URL	250" H2O
Min ambient working temp	-40 F	Max	175 F

ACCESSORIES	
Air set filter style	
Air set gauges	
Heating kit style	
Remote indicator style	
Manifold valve style	

SPECIAL REQUIREMENTS	
Custom tag	ssl wired-on
Reference specification	13341 2.03
Special preparation	
Compliance standard	
Software configuration	

PHYSICAL DATA			
Estimated weight	13 Lbs		
Overall height	7.54"		
Removal clearance			
Signal con nominal size	1/2"	Style	NPT
Mfr reference dwg			

CALIBRATIONS AND TEST		INPUT			OUTPUT OR SCALE	
TAG NO/FUNCTIONAL IDENT	MEAS/SIGNAL/TEST	LRV	URV	ACTION	LRV	URV
FIT-3510-1, 2, 3, 4	Diff press-Analog output	0 in. H20	30 in H2O	Direct	4 mA	20 mA
	Diff pressure Scale					
	Diff press-Digital output					
	Press-Digital output					
	Temp-Digital output					

COMPONENT IDENTIFICATIONS		
COMPONENT TYPE	MANUFACTURER	MODEL NUMBER
Diff. Pres. XMTR	Rosemount	3051CD2A2A1AS5E5M5Q4
Manifold	Rosemount	0305RC52B11B4

Rev	Date	Revision Description	By	Appv1	Appv2	Appv3	REMARKS

Form: 20P2301 Rev 0

1	RESPONSIBLE ORGANIZATION		MAGNETIC FLOWMETER	6	SPECIFICATION IDENTIFICATIONS	
2		CDM Constructors	w/wo INTEGRAL TOTALIZER INDICATOR	7	Document no	
3	ISA	25 Industrial Ave	Device Specification	8	Latest revision	A Date 7/18/11
4		Chelmsford, MA		9	Issue status	
5		01824		10		

11	FLOWMETER BODY		60	TOTALIZER INDICATOR	
12	Body type	flanged-std form	61	Totalizer type	
13	Flow tube style	manufacturer standard	62	Enclosure type no/class	
14	End conn nominal size	6 in Rating cl 150	63	Signal power source	
15	End conn termn type	flanged Style	64	Contacts arrangement	Quantity
16	Flow tube diameter	5.98" Thickness	65	Totalizer reset style	
17	Hardware mounting kit	flange w/bolting	66	Integral indicator style	
18	Flow tube material	Carbon Steel	67	Cert/Approval type	
19	Lining material	Polyurethane	68	Mounting location/type	
20	End termination material	carbon steel	69	Enclosure material	
21	Gnd/protective ring matl	316L SST	70		
22			71	PERFORMANCE CHARACTERISTICS	
23			72	Min press at design temp	At
24	END EXTENSIONS		73	Max press at design temp	285 psi
25	End termination type	Style	74	Min working temperature	0 F Max 140 F
26	Bolting material		75	Accuracy rating	.25 %
27	End termination material		76	Min velocity URL	.04 Ft/sec Max 30 Ft/sec
28	Gasket/O ring material		77	Min liquid conductivity	5 microsiemens/cm
29			78	Output signal damping LRL	URL
30	SENSING ELEMENT		79	Min ambient working temp	-20 F Max +140 F
31	Electrode type	2 Electrode - Standard	80	Contacts ac rating	At max
32	Insertion length		81	Contacts dc rating	At max
33	Electrode material	316L SST	82	Max sensor to receiver lg	
34	Electrode Housing	Sealed, Welded w/sep comp	83		
35	COILS AND HOUSING		84		
36	Housing construction type	Manufacturer Standard	85		
37	Coil conn arrangement		86	ACCESSORIES	
38	Enclosure type no/class	NEMA 4X	87	Connecting cables length	
39	Signal power source	From transmitter	88	Cable Glands	
40	Signal termination type		89	Ultrasonic cleaner style	
41	Cert/Approval type		90	Empty tube detector	
42	Housing material		91	Calibrator adaptor	
43			92	Calibrator/configurator	
44			93		
45	TRANSMITTER OR CONVERTER		94	SPECIAL REQUIREMENTS	
46	Housing type	general purpose enclosure	95	Custom tag	SST Permanent or Wired
47	Output signal type	analog current	96	Reference specification	
48	Enclosure type no/class	NEMA 4x	97	Compliance standard	
49	Characteristic curve	linear with flow volume	98	Calibration report	Included
50	Digital communication std	Hart	99	Software configuration	
51	Signal power source	line 120 V(ac) 60 Hz	100		
52	Failsafe style		101	PHYSICAL DATA	
53	Integral indicator style		102	Estimated weight	81 lbs.
54	Signal termination type	terminal block	103	Face-to-face dimension	11.81 in
55	Cert/Approval type	CSA, FM	104	Overall height	9.45
56	Mounting location/type	Integral	105	Removal clearance	
57	Failure/Diagnostic action		106	Signal conn nominal size	1/2 in Style nct
58	Enclosure material	Low-Copper Aluminum	107	Mfr reference dwg	
59			108		

110	CALIBRATIONS AND TEST		INPUT OR TEST			OUTPUT OR SCALE	
111	TAG NO/FUNCTIONAL IDENT	MEAS/SIGNAL/TEST	LRV	URV	ACTION	LRV	URV
112	FE/FIT-2552-X,FE/FIT-6503	Flow rate-Analog output	Per Inst List	Per Inst. List	Direct	4 mA	20 mA
113		Flow rate-Digital output					
114		Flow rate-Freq output					
115		Flow rate-Scale					
116		Test pressure					
117							

118	COMPONENT IDENTIFICATIONS		
119	COMPONENT TYPE	MANUFACTURER	MODEL NUMBER
120	6 " Flowtube Sensor	Rosemount	8750WA32EST1A1FPSE0600A1NHM4G5C4
121			
122			
123			
124			
125			

Rev	Date	Revision Description	By	Appv1	Appv2	Appv3	REMARKS

Form: 20F2321 Rev 0

Example manufacturer's data sheet patterned after ISA format

imagination at work						Specification
Online Total Organic Carbon (TOC) Analyzer						
General	1	Tag No.	Tag Rev.			
	2	P&ID No.				
	3	Line No.	Equip No.			
	4	Line Size				
	5	Line Spec				
	6	Area Classification		Non-Hazardous		
	7					
Process Data	8	Fluid	Fluid Phase			Liquid
	9	Flow	Min/Oper/Max	50 mL/min		N/A
	10	Pressure	Min/Oper/Max	2 psig (0.14bar)		250 psig (17.2bar)
	11	Temp	Min/Oper/Max	1C		95C
	12	Conductivity	Min/Oper/Max	0.055 uS/cm		N/A
	13	TOC	Min/Oper/Max	4 ppb		50,000 ppb
Sensor	14	Type	Analysis Method	On-Line Integral		UV/MC
	15	Analysis Modes		Online, Grab		
	16	Analysis Time		4 Minutes		
	17	Inlet Connection	Connection Size	Swagelok Compression		0.25 inch
	18	Outlet Connection	Connection Size	Barbed		0.5 inch
	19	Surface Finish	Wetted/Non Wetted	Mfg Std		Mfg Std
	20	Ozone Continuous	Ozone Periodic	w/opt ozone destruct kit		w/opt ozone destruct kit
	21	Sample Temp Rng	Sample Press Rng	1 to 95 C		2-250psig (0.14-17.2bar)
	22	Raw Cond Rng	Max Sample Cond	N/A		N/A
	23	Cond Accuracy	Cond Precision	N/A		N/A
	24	TOC Range		4 to 50,000 ppb		
	25	TOC Accuracy	TOC Precision	+/- 2% or 0.5ppb		< 1% of RSD
Transmitter	26	Type		Integrated		
	27	Full Span	Lower/Upper	0 ppb		50,000 ppb
	28	Calib Range	Lower/Upper	0 ppb		50,000 ppb
	29	Accuracy		same as sensor		
	30	Enclosure Material	Enclosure Rating	Powder Coated Alum		IP45
	31	Electrical Connection		Hard wire 100 to 240 VAC, 100W, 50/60hz		
	32	Analog Output	Signal Communication	1		RS232, USB
	33	Display Type		QVGA Touchscreen		
	34	Manufacturer		**GE Analytical Instruments**		
	35	Model No.		**5310C Online**		
	36					
Other	37	Wetted Materials		316L SS, PTFE, CPVC (Sampler)		
	38	Calibration Stability		12 months		
	39	Interferences		Insensitive to organic heteroatoms		
	40	Ambient Temperature		10-40 C		
	41	Max Relative Humidity		95% noncondensing		
	42	Maximum Altitude		3,000 m (9843 ft)		
	43	Inputs		One isolated binary input		
	44	Outputs		(1) isolated 4-20mA, Ethernet (Modbus TCP/IP)		
	45	Outputs		(1) RS232, (1) USB, (1) printer, (2) alarm		
	46	Safety Certifications		ETL conforming to UL 61010-1, CE		
	47	Dimensions		24.6"x17.8"x10.4" (62.4x45.2x26.4cm) (HxWxD)		
	48	Weight		16.9 kg (37 lbs)		
Notes	Options: ICR (for waters high in inorganic carbon), Pre-filter kits (for raw water), Multi-stream device					

Appendix E

Field Input

Testing and Commissioning

PLC: _____

Input: _____

Loop: _____

Low: _____

High: _____

EGU: _____ (analogs)

Date: _____

Test	Testing	Commissioning
Input observed in the PLC memory	_____	_____
Input converted to the correct EGU	_____	_____
Input read by Cimplicity	_____	_____
Input displayed properly on screen	_____	_____
Input displayed properly when alarming	_____	_____
Input on alarm banner when alarming	_____	_____
Input logged to Cimplicity Logging		_____
Table used for Logging		_____
Alarm logged to Cimplicity Logging		_____
Cimplicity can reset alarm (if appl)	_____	_____

Field Output

Testing and Commissioning

PLC: _____

Input: _____

Loop: _____

Low: _____

High: _____

EGU: _____ (analogs)

Date: _____

Test	Testing	Commissioning
Output observed in the PLC memory	_____	_____
Output has intended affect in PLC logic	_____	_____
Output gets to the I/O module (if appl)	_____	_____
Output written by Cimplicity	_____	_____
Output displayed properly on screen	___	_____
Output logged to Cimplicity Logging _____		
Table used for Logging		_____

Motor

Testing and Commissioning

PLC: _____

Device: _____

Loop: _____

Date: _____

Test		Testing	Commissioning
Monitor ready/not ready/auto (YA)			
Monitor PLC/local	(YN)		
Monitor run	(MN)		
Monitor/field alarm	(MF)		
Monitor speed	(SI)		
PLC manual start			
PLC manual stop			
PLC set speed			
PLC fail to start, reset alarm			
PLC fail while running, reset alarm			
PLC fail to stop, reset alarm			
Automatic start			
Automatic stop			
Tagged stop/lockout			
Process interlocks			

Valve

Testing and Commissioning

PLC: _____

Device: _____

Loop: _____

Date: _____

Test		Testing	Commissioning
Monitor PLC/local	(YN)		
Monitor full open limit	(ZH)		
Monitor full closed limit	(ZL)		
Monitor valve position	(ZI)		
PLC manual open			
PLC manual close			
PLC set position			
PLC fail to open, reset alarm			
PLC fail to stay open, reset alarm			
PLC fail to close, reset alarm			
PLC fail to stay closed, reset alarm			
PLC control of position			
Automatic open			
Automatic close			
Tagged lockout			
Process interlocks			

Control Strategy

Testing and Commissioning

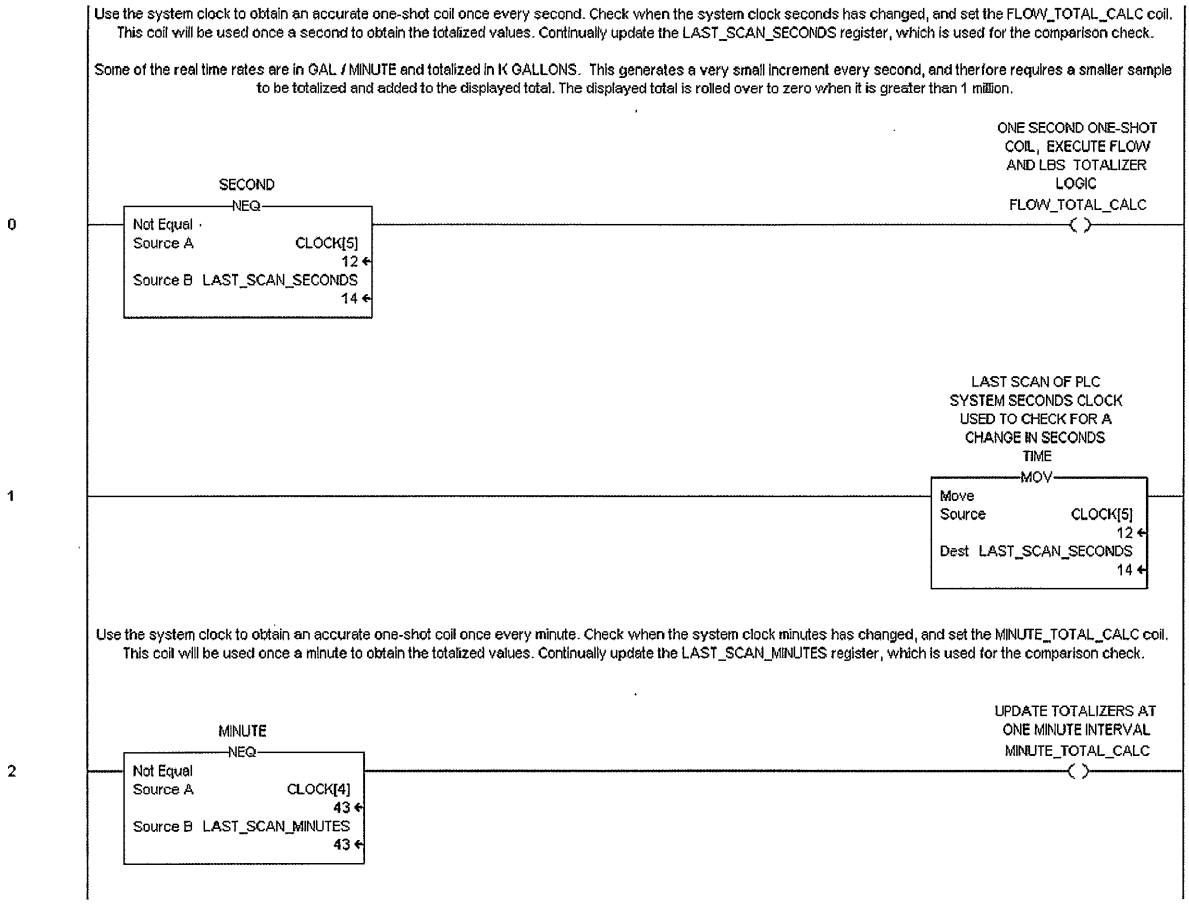
PLC: _____

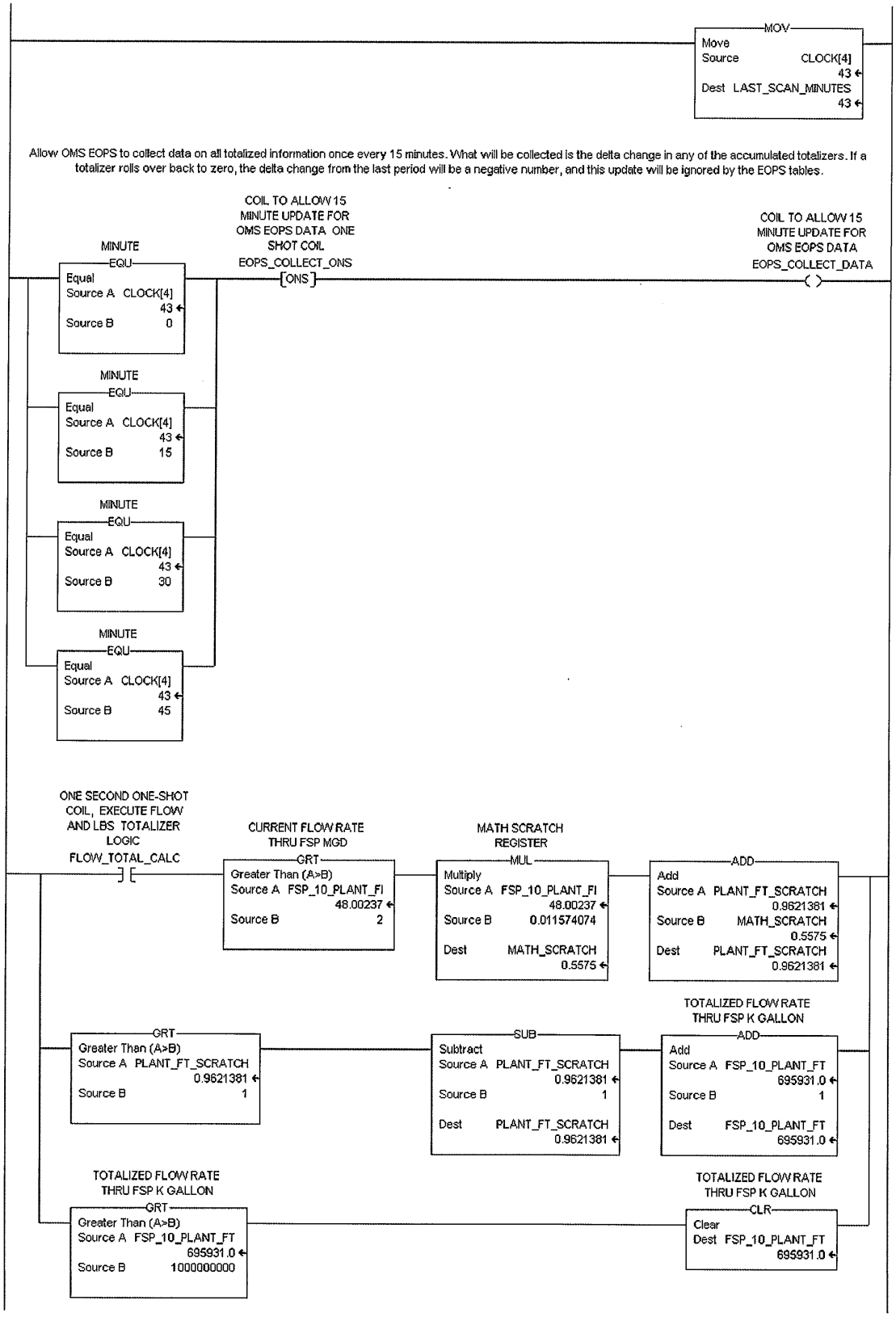
Strategy: _____

Date: _____

Test	Testing	Commissioning
Field Control Functionality		
Manual Control Functionality		
Automatic Control Functionality		
Interlock Functionality		
Alarm Functionality		

Appendix F


Use the system clock to obtain an accurate one-shot coil once every second. Check when the system clock seconds has changed, and set the FLOW_TOTAL_CALC coil. This coil will be used once a second to obtain the totalized values. Continually update the LAST_SCAN_SECONDS register, which is used for the comparison check.
Some of the real time rates are in GAL / MINUTE and totalized in K GALLONS. This generates a very small increment every second, and therfore requires a smaller sample to be totalized and added to the displayed total. The displayed total is rolled over to zero when it is greater than 1 million.
ONE SECOND ONE-SHOT COIL, EXECUTE FLOW AND LBS TOTALIZER LOGIC
FLOW_TOTAL_CALC
SECOND
NEQ
Not Equal
Source A CLOCK[5] 12
Source B LAST_SCAN_SECONDS 14
0
LAST SCAN OF PLC SYSTEM SECONDS CLOCK USED TO CHECK FOR A CHANGE IN SECONDS TIME
MOV
Move
Source CLOCK[5] 12
Dest LAST_SCAN_SECONDS 14
1
Use the system clock to obtain an accurate one-shot coil once every minute. Check when the system clock minutes has changed, and set the MINUTE_TOTAL_CALC coil. This coil will be used once a minute to obtain the totalized values. Continually update the LAST_SCAN_MINUTES register, which is used for the comparison check.
UPDATE TOTALIZERS AT ONE MINUTE INTERVAL
MINUTE_TOTAL_CALC
MINUTE
NEQ
Not Equal
Source A CLOCK[4] 43
Source B LAST_SCAN_MINUTES 43
2


3
MOV
Move
Source CLOCK[4]
43
Dest LAST_SCAN_MINUTES
43
Allow OMS EOPS to collect data on all totalized information once every 15 minutes. What will be collected is the delta change in any of the accumulated totalizers. If a totalizer rolls over back to zero, the delta change from the last period will be a negative number, and this update will be ignored by the EOPS tables.
4
COIL TO ALLOW 15 MINUTE UPDATE FOR OMS EOPS DATA ONE SHOT COIL
EOPS_COLLECT_ONS
ONS
COIL TO ALLOW 15 MINUTE UPDATE FOR OMS EOPS DATA
EOPS_COLLECT_DATA
MINUTE
EQU
Equal
Source A CLOCK[4]
43
Source B 0
MINUTE
EQU
Equal
Source A CLOCK[4]
43
Source B 15
MINUTE
EQU
Equal
Source A CLOCK[4]
43
Source B 30
MINUTE
EQU
Equal
Source A CLOCK[4]
43
Source B 45
5
ONE SECOND ONE-SHOT COIL, EXECUTE FLOW AND LBS TOTALIZER LOGIC
FLOW_TOTAL_CALC
CURRENT FLOW RATE THRU FSP MGD
GRT
Greater Than (A>B)
Source A FSP_10_PLANT_FI
48.00237
Source B 2
MATH SCRATCH REGISTER
MUL
Multiply
Source A FSP_10_PLANT_FI
48.00237
Source B 0.011574074
Dest MATH_SCRATCH
0.5575
ADD
Add
Source A PLANT_FT_SCRATCH
0.9621381
Source B MATH_SCRATCH
0.5575
Dest PLANT_FT_SCRATCH
0.9621381
GRT
Greater Than (A>B)
Source A PLANT_FT_SCRATCH
0.9621381
Source B 1
SUB
Subtract
Source A PLANT_FT_SCRATCH
0.9621381
Source B 1
Dest PLANT_FT_SCRATCH
0.9621381
TOTALIZED FLOW RATE THRU FSP K GALLON
ADD
Add
Source A FSP_10_PLANT_FT
695931.0
Source B 1
Dest FSP_10_PLANT_FT
695931.0
TOTALIZED FLOW RATE THRU FSP K GALLON
GRT
Greater Than (A>B)
Source A FSP_10_PLANT_FT
695931.0
Source B 1000000000
TOTALIZED FLOW RATE THRU FSP K GALLON
CLR
Clear
Dest FSP_10_PLANT_FT
695931.0

On the 15 minute data collection time period, this rung will first take the TOTALIZER and subtract the LASTSAMPLE , and store the result in MATH SCRATCH. This is the net change in value of the totalizer from the last 15 minute period. Next, the current TOTALIZER is moved to the LASTSAMPLE so it is now updated. Next, check if the net change in MATH SCRATCH is greater or equal to zero, and if so, update the QX 15 minute EOPS data with the change.

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