

**WATERWORKS SYSTEM
ASSESSMENT REPORT**

FOR:

**CITY OF
MELFORT,
SASKATCHEWAN**



CATTERALL & WRIGHT
Consulting Engineers
1221 – 8th Street East
Saskatoon SK S7H 0S5
Phone 343-7280, Fax 956-3199
E-mail: cw@cwce.ca

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1.0 Background and General Overview

1.1 General

Melfort, Saskatchewan, has a population of 5,890 persons (SHSP, 2005). Treated water is supplied to the City by SaskWater. The City owned storage reservoirs at the WTP are operated and utilized by SaskWater. The City provides pumping to the distribution system from reservoirs at the SaskWater water treatment plant.

1.2 Location

The Melfort waterworks is located in SE ¼ 8-45-2 W 2nd.

1.3 Inspection of Waterworks System

The waterworks system inspection took place November 17, 2005. The City Public Works Director, Don Graham, and an operator, Elizabeth McLean, were interviewed.

1.4 Waterworks System Time Line

The water distribution pumps were installed in 1993. Construction of the distribution system began in the 1920's. The City has an on-going program to replace the old cast and ductile iron watermains.

1.5 Operators and Certification

At the time of inspection, the City had three certified operators, with plans for several additional in the coming year. The highest certification levels are WD3 and WT1. At the time of inspection, the City had one uncertified backup operator.

2.0 Review of Available Information

2.1 Plans, Reports, and Manuals

Plans, Reports, and Manuals, as listed in Appendix B, were supplied by the City for review. The reviewed plans include the complete City utility plans. The utility plans are maintained by Catterall and Wright and are regularly updated with information provided by the City. The City records are generally complete and well kept.

Reports from the Environmental Project Officer (EPO) were provided. The reports have generally been favourable.

2.2 Historic Problems

The City has previously had difficulties with watermain breaks, turbidity in the distribution system, and low disinfectant levels on a long dead end supply main.

3.0 Water Usage Analysis

3.1 Population

Table 3.1 is a summary of population statistics for the City based on Census data from Statistics Canada and Covered Population information from Saskatchewan Health (SHSP). SHSP figures tend to overestimate the actual population. Both the SHSP and Census populations indicate a similar, slightly declining population. A current population of 5890 and a small future growth of 0.25% will be used for analyses herein.

Table 3.1 – Population Summary

Year	Census	SHSP
2005		5890
2004		5898
2003		5844
2002		5927
2001	5559	5970
2000		6024
1999		6114
1996	5759	5902
1991	5628	5935

3.2 Consumption and Sizing

A water usage analysis and projection was completed based on data supplied by the City. The results of the analysis are shown in Table C.1, Appendix C. The average annual raw water consumption during the last five years was approximately 779,600 m³/year. The average daily per capita water usage for the last five years has been approximately 360 Lpcd (litres per capita per day). Saskatchewan Watershed Authority statistics indicate an average of 356-380 Lpcd for a Saskatchewan community of this size. The unit cost for water was increased between 2000 and 2004 and per capita consumption fell significantly. Per capita consumption in 2004 was 313 Lpcd. For this analysis and to be conservative, an average demand of 350 Lpcd is used.

Peaking factors are used to determine various sizing requirements. The required size is determined by multiplying the average daily consumption by the peaking factors. Peak day demand data was unavailable. Peak day demand is used to calculate required supply and treatment rates based on a 24 hour day. For a community of this size, the Saskatchewan Watershed Authority recommends a peak day factor of 2.0. For distribution pump sizing, the peak hour usage must be estimated. For a community of this size, the Watershed Authority recommends a peak hour factor of 3.0.

Based on the 2004 water usage data, a population of 5898 persons and the aforementioned peaking factors, the current water requirements are estimated and summarized in Table 3.3. Further analysis and a 20 year projection, based on the

same peaking factors, a 2005 population of 5890 and a per capita demand of 350 Lpcd, are included in Table C.1

Table 3.3 – Current Water Requirements (2004)

Recorded Average Day (m³)	Estimated Peak Day (m³)	Estimated Supply Rate (Lps)	Pumping Rate (Lps)	Storage (m³)
1,845	3690	42.7	64.1	3690

4.0 Waterworks System

4.1 Water Supply

4.1.1 SaskWater Supply

Potable water is supplied to the City by SaskWater at their Melfort Water Treatment Plant (WTP). The City's pumps at the SaskWater WTP supply the distribution system. The contract with SaskWater is for an average supply rate of 22.0 Lps and a daily maximum rate of 52.7. The contract also states that, to the extent possible, as much water as is needed will be supplied.

The average supply rate is approximately equal to the average day use, but is smaller than the forecasted requirements. The daily maximum rate is greater than the forecasted requirement.

4.2 General Water Treatment Facilities

The City facilities are minor because of the supply arrangement with SaskWater. The City owned storage reservoirs at the SaskWater WTP are operated, maintained, and utilized by SaskWater. The City pumps and appurtenances at the WTP appear to be well maintained.

The electrical equipment (Photo 6) appears in good condition and the City does not report any problems.

4.3 Treated Water Storage

The City owns 2 storage reservoirs separate from, but on the SaskWater WTP site. The reservoirs are operated, including cleaning and monitoring, and used by SaskWater. Water for both the Rural water supply and the City water supply pass through the reservoirs. This report only addresses storage capacity. All other aspects are assumed to be addressed by the reservoir operator.

The partially buried, circular, concrete reservoirs were constructed in the early 1970's. The reservoirs have a capacity of approximately 3400 m³ each, for a total available storage of approximately 6800 m³. In 2005, the City usage accounted for approximately 68.5% of the total usage. At this flow distribution, the available storage is sufficient to meet the current and forecasted needs for 20

years. The agreement with SaskWater also stipulates that in the event of a supply interruption, that the stored water will be for the exclusive use of the City.

4.4 Water Treatment Process

4.4.1 General

The City of Melfort does not provide any additional treatment of the water supplied. The City pumps water from a reservoir at the SaskWater Melfort WTP to the distribution system.

4.4.2 Disinfection

Primary disinfection of the water supplied to the City is achieved by SaskWater. This system, therefore, does not require disinfection analysis.

Residual disinfection of the water supplied to the City is provided by free chlorine. The residual chlorine concentration is typically 0.5 mg/L or greater in the distribution system, except as noted below.

The City does not have facilities to boost chlorine levels.

Low chlorine levels have resulted in a Precautionary Boil Water Advisory for users south of the City on the Agriculture Canada extension. City records suggest that the low chlorine levels are likely due to low usage of the main. The main is 150mm CI. A bleeder valve on the end of the pipeline may help residual levels.

4.4.3 Treated Water Quality

Treated water quality analyses were provided by the City. A summary of the analyses is shown in Appendix A. The potable water provided to the City is of good quality.

4.5 Distribution System

Water is supplied to the distribution system by three vertical turbine pumps located in the WTP pump room. A diesel engine driven, horizontal-split case, centrifugal standby pump is also available for power failures and fire situations. One of the distribution pumps is VFD controlled and varies its speed to maintain a set distribution system pressure. Pressure is also maintained with a pressure relief valve in the pump room.

Pump Nos. 1 and 2 are Layne-Vertiline 50 hp 12RKBL – 3 stage vertical turbine pumps with a rated capacity of 52.0 Lps at a total dynamic head of 53.0 m. (Photo 1). Pump No. 3 is a Layne-Vertiline 75 hp 12KHMM – 4 stage vertical turbine pump with a rated capacity of 78.2 Lps at a total dynamic head of 53.0 m. All of the service pumps have 575V, three phase electric motors.

The diesel engine driven, standby pump is a Peerless horizontal split case centrifugal model 5300 8AD17 and has a capacity of 189.3 Lps at a total dynamic head of 70.1 m. (Photos 4 and 5). The engine and pump are reported to be in

good condition. The engine is automatically started when distribution system pressure falls. The engine is old and repair parts are becoming difficult to obtain. The City is examining options for replacement.

The available capacity of the service pumps is adequate to meet the current and future usage with appropriate redundancy.

The sleeve through the floor for the pressure relief valve (Photo 1) is recommended to have a cover added to prevent entry of debris in the reservoir.

Flow to the distribution system is metered by both SaskWater (Photo 2) and the City (Photo 3).

The distribution system was first installed in the 1920's, with most of the system constructed in between 1920 and 1940. There are asbestos cement, ductile iron, cast iron, and PVC water mains. The city reports that the ductile iron and cast iron mains are in very poor condition and has an on-going replacement program. The majority of the water mains are 150 mm diameter with 200, 250, and 300 mm mains in higher flow areas. Valve spacing is adequate. The City reports a total of 52,650 m of watermain.

The water distribution system was analyzed using a computer model and reported on in 1992 by UMA Engineering. The modelling was based on pressure and flows during peak hour usage and peak day plus fire flow. The report recommends the completion of the 250 mm primary main loop through the City, as well as extension along MacDonald Road to improve supply to the north west industrial area. Other pipe size increases were recommended through the central business district. As existing mains are replaced, the pipe sizes should be increased as suggested in the report.

After watermain breaks, the City reports significant difficulty with localized turbidity spikes in the distribution system caused by changes of flow distribution. The turbid water is dealt with by flushing. The City is proactive in these situations and appropriately advises users likely to be affected.

A backflow study has not been completed for this system. Backflow prevention is not provided at any of the old service connections within the City. The City reports that a backflow preventer has been required on new construction since 2000. A backflow study and development of a backflow prevention policy are recommended. In the interim, some of the more likely sources of contamination, such as car washes, restaurants, institutional buildings, and industrial users should be reviewed to determine if backflow prevention is required. Further all high rise buildings that do not have backflow preventers, must have one added to their service.

4.6 Fire Protection

For a system which provides fire protection, two times the average daily use is recommended for storage. Information contained in the water supply contract with SaskWater indicates that two day storage plus an amount for fire is available.

Fire flow is provided by the service pumps and the engine driven pump described in Section 4.5. A capacity of 75.7 Lps is generally considered adequate for residential systems. This may not be adequate for other structures, however further study would be required. Fire hydrant spacing is adequate.

The 1992 distribution system analysis examined fire flow. A flow test performed for the analysis indicates that the available fire flow was approximately 82.6 Lps at the Leisure Centre, near the central business district. The report suggests that a future (year 2020) fireflow of 265 Lps is required in the central business district. Watermain replacements suggested in the report are intended to provide the required fire flow with appropriate distribution system pressures. Watermain replacements as outlined in the report should be continued. It is recommended that the fire requirements of significant users (eg. large buildings, industry) also be reviewed to ensure the required capacity is available.

4.7 Operation and Maintenance

4.7.1 Testing Procedures and Records

The City has a Hach Pocket II Colorimeter (chlorine) and a Hach 2100P Turbidimeter. Both pieces of equipment are in good condition. The Town tests regularly for both. The Operators have written procedures that indicate when and where testing is to be performed.

Daily testing records are maintained at the City Maintenance Yards. The records are well kept and appear to be complete. Other records for the water system (main breaks, poor water quality, low pressure) are well kept and thorough.

4.7.2 Operation and Maintenance

The water system equipment is maintained in very good condition.

5.0 Recommendations

Issues & Risks are those items which have potential to adversely affect the ability to supply safe drinking water. Recommended Improvements are items of system improvement.

5.1 Issues & Risks

There are no Issues or Risks.

5.2 Recommended Improvements

5.2.1 Sleeve Cover

The installation of split cover over the sleeve through the floor in the pump room at the WTP is recommended to prevent entry of debris into the reservoir below.

5.2.2 Backflow Study

A backflow study is recommended to be undertaken. The estimated cost is \$10,000 to \$15,000.

5.2.3 Fire Protection Requirements

It is recommended that the fire requirements of significant users be reviewed.

5.3 Estimated Capital Replacement Costs and Remaining Service Life

The estimated capital replacement costs and remaining service life are shown in Table 5.1. These costs represent the replacement value of the system as it existed at the time of inspection.

Table 5.1 Estimated Capital Replacement Cost and Remaining Service Life

Component/Item	Year(s) Constructed	Typical Service Life (years)	Estimated Remaining Service Life (years)	Estimated Replacement Value
Water Pumping Station*:				\$3,750,000
Storage	1970	40-50	5-15	
Mechanical	1993	20-30	10-20	
Pumps & Motors	1993	20-30	10-20	
Electrical System	1993	20-30	10-20	
Distribution System:				
Watermains (52,650 m)	1920-2005	30-50	0-50	\$11,800,000
Total Estimated Capital Replacement Cost				\$15,550,000

* - cost only for City owned facilities, not SaskWater owned buildings etc

6.0 Conclusion

The general condition of the Melfort water system is good.

We trust that the foregoing report fulfills the requirements for this assessment. If you require further information, please contact our office.

"I, the undersigned, hereby declare that to the best of my knowledge, the information contained herein and the information in support of this submission as completed by me is complete and accurate in accordance with my obligations under *The Engineering and Geoscience Professions Act (2000)* and its regulations. I further declare that this submission has been prepared in accordance with the published standard for this submission."

Respectfully submitted,

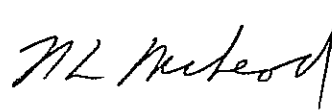
Catterall and Wright

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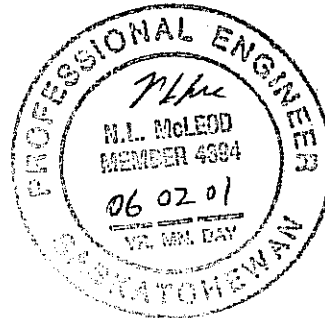


Shaun McLeod, E.I.T.

Reviewed:



N. Lyle McLeod, P.Eng.



Appendix A
Water Quality Data

Table A.1 - City of Melfort Water Quality Analysis Results

Analyte	Units	SDWQS	Treated	Treated	Treated	Treated
Date			30-Jul-02	12-Nov-02	04-Apr-05	31-Aug-05
Bicarbonate	mg/L			144		
Calcium	mg/L			55		
Carbonate	mg/L			<1		
Chloride	mg/L	250 ‡		9		
Hydroxide	mg/L					
Magnesium	mg/L			17		
pH	pH units	6.5 to 9.0 ‡		7.48		
Potassium	mg/L					
Sodium	mg/L	300 (200) ‡		21		
Specific conductivity	uS/cm			483		
Sulphate	mg/L	500 ‡		111		
TDS (calc)	mg/L	1500 (500) ‡		361		
Total Alkalinity	mg/L	500 ‡		118		
Total Hardness	mg/L	800 ‡		207		
Nitrate	mg/L	45		0.99		
Turbidity	NTU				0.15	0.17
Mercury	mg/L	0.001	<0.00005			
Organic Carbon, dissolved	mg/L					
Aluminum	mg/L	(0.200) ‡		0.016		
Arsenic	mg/L	0.025 †	<0.0005			
Barium	mg/L	1	0.064			
Boron	mg/L	5 †	0.023			
Cadmium	mg/L	0.005	<0.001			
Chromium	mg/L	0.05	<0.001			
Copper	mg/L	1 ‡	0.005			
Iron	mg/L	0.3 ‡		0.005		
Lead	mg/L	0.01	<0.001			
Manganese	mg/L	0.05 ‡		0.011		
Selenium	mg/L	0.01	<0.001			
Zinc	mg/L	5 ‡	<0.005			
Uranium	mg/L	0.02 †	<0.0005			
Fluoride	mg/L	1.5				
Ammonia as Nitrogen	mg/L					
Total coliform	ct/100ml					
Fecal coliform	ct/100ml					
True Color	APHA	15 ‡				
Total THM	mg/L	0.1				

Water Quality data supplied by the City of Melfort

† IMAC

* Calculated

SDWQS - Saskatchewan Drinking Water Quality Standards

‡ Aesthetic Objective

() Bracket Values - Guidelines for Canadian Drinking Water Quality

Table A.2 - City of Melfort Water Quality Analysis Results

Analyte	Units	SDWQS	Treated Water			
Date			30-Jul-02			
1,2 - Dichlorobenzene	mg/L	0.2	<0.0005			
1,2 - Dichlorothane	mg/L	0.005	<0.0005			
1,4 - Dichlorobenzene	mg/L	0.005	<0.0005			
2,3,4,6 - Tetrachlorophenol	mg/L	0.1	<0.0005			
2,4,6 - Trichlorophenol	mg/L	0.005	<0.0002			
2,4 -D	mg/L	0.1	<0.0005			
2,4 - Dichlorophenol	mg/L	0.9	<0.0002			
Atrazine	mg/L	0.005	<0.00005			
Benzene	mg/L	0.005	<0.0002			
Benzo (A) Pyrene	mg/L	0.0001	<0.00001			
Bromoxynil	mg/L	0.005	<0.0005			
Carbon Tetrachloride	mg/L	0.005	<0.0005			
Chlorobenzene	mg/L	0.08	<0.0005			
Dicamba	mg/L	0.12	<0.0005			
Diclofop-Methyl	mg/L	0.009	<0.001			
Ethyl Benzene	mg/L	0.0024	<0.0002			
Methylene Chloride	mg/L		<0.0005			
Pentachlorophenol	mg/L	0.06	<0.0005			
Picloram	mg/L	0.19	<0.001			
Toluene	mg/L	0.024	<0.0002			
Trichloroethylene	mg/L	0.05	<0.0005			
Trifluralin	mg/L	0.045	<0.00005			

Water Quality data supplied by the City of Melfort

SDWQS - Saskatchewan Drinking Water Quality Standards

() Bracket Values - Guidelines for Canadian Drinking Water Quality

† IMAC

‡ Aesthetic Objective

* Calculated

Appendix B
List of Plans, Reports and Manuals

Appendix C
Tables, Figures and Drawings

Contents:

Table C.1 – Water Usage Analysis	1 page

Table C.1 – City of Melfort Water Usage Analysis

Year	Estimated Population	Data			Calculated			Required Capacities [†]		
		Annual Water Use(m ³)	Peak Day (m ³)	Average Day (m ³)	Peak Day Factor	Average Usage Per capita per day (Lpcd)	Supply Rate (Lps) Rate (Lps)	Pumping Rate (Lps)	Storage (m ³)	
2000	6024	867,732	4,754	2,377	2.00	395	55.0	82.5	4754	
2001	5970	880,181	4,822	2,411	2.00	404	55.8	83.7	4822	
2002	5927	734,836	4,026	2,013	2.00	340	46.6	69.9	4026	
2003	5844	741,800	4,064	2,032	2.00	348	47.0	70.6	4064	
2004	5898	673,530	3,690	1,845	2.00	313	42.7	64.1	3690	
2005	5890	752,448	4,123	2,062	2.00	350	47.7	71.6	4123	
2010	5964	761,901	4,175	2,087	2.00	350	48.3	72.5	4175	
2015	6039	771,482	4,227	2,114	2.00	350	48.9	73.4	4227	
2020	6115	781,191	4,281	2,140	2.00	350	49.5	74.3	4281	
2025	6192	791,028	4,334	2,167	2.00	350	50.2	75.3	4334	

Estimated - peak day usage data unavailable. Peak estimated at 2x average.

Estimated population based on Saskatchewan Health data and 0.25% future growth rate

† As suggested by Saskatchewan Watershed Authority Community Water Use Records Report No. 16

Supply Rate based on peak day use (2x average) and 24 hour production day

Distribution pumping rate based on 3.0 times average day use

Storage based on 2 times average day use

Appendix D
Pictures

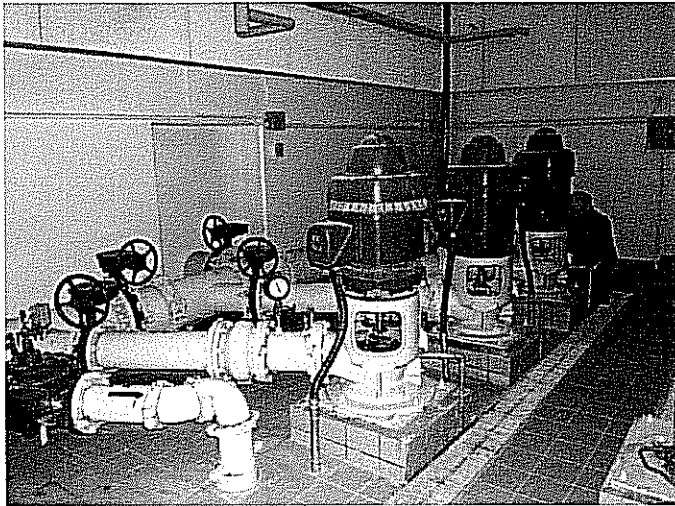


Photo 1
Service Pumps and pressure relief valve

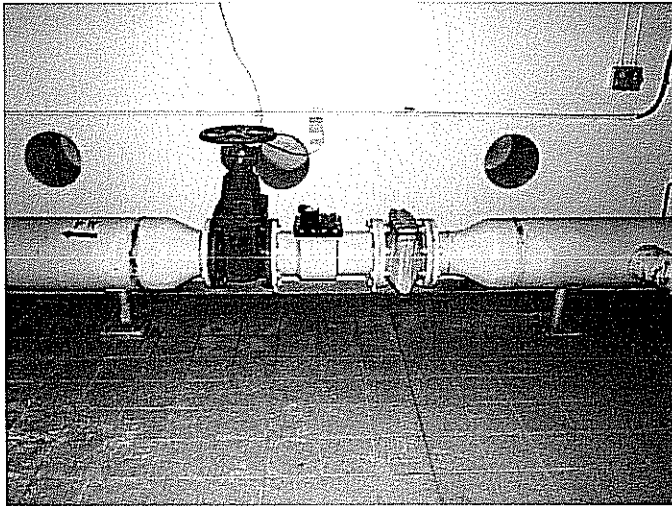


Photo 2
SaskWater
Turbine Meter

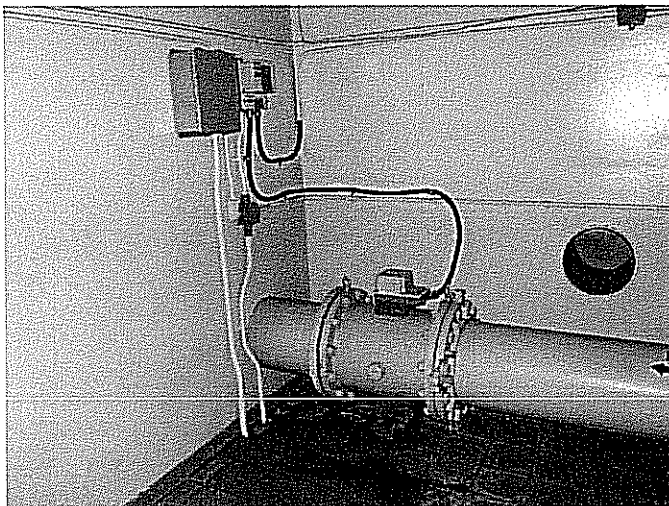


Photo 3
City of Melfort
Magnetic Flow Meter

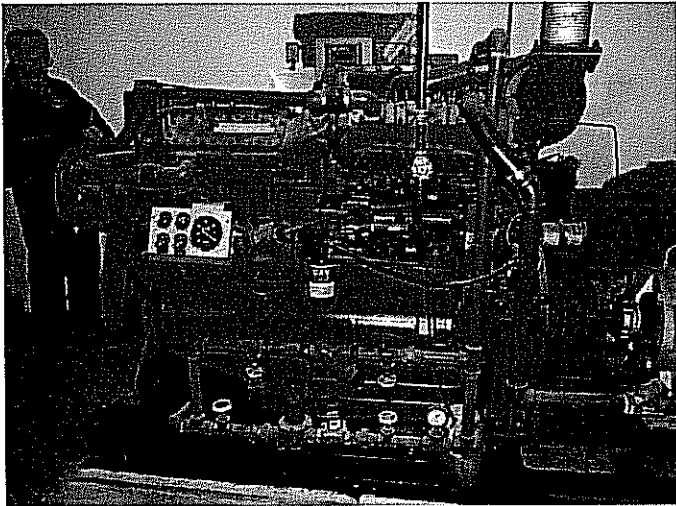


Photo 4
Standby Engine

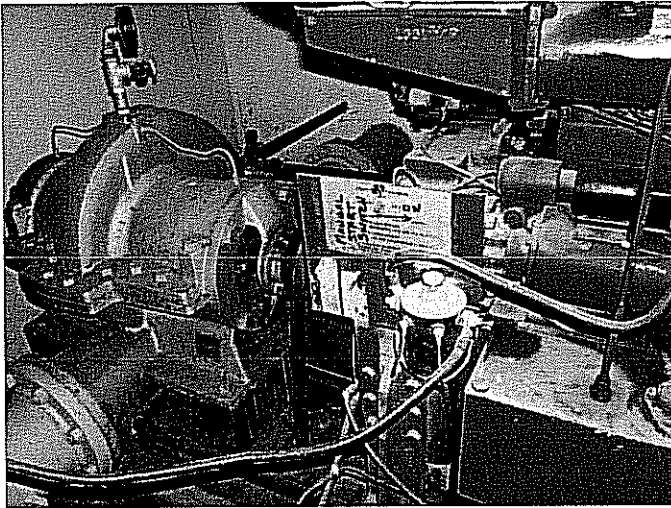


Photo 5
Standby Pump

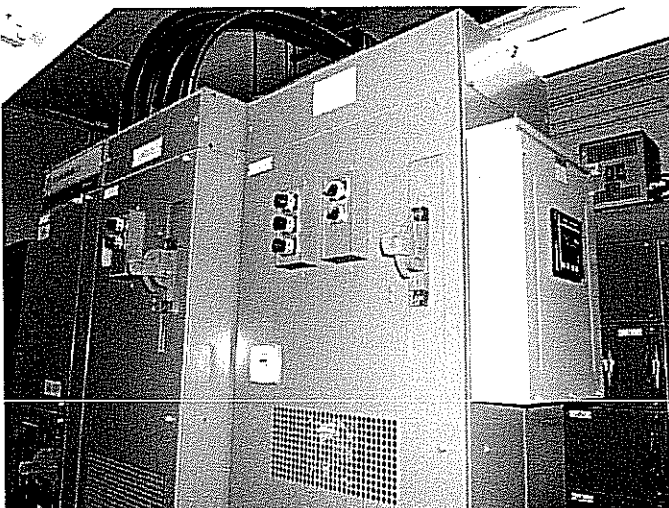


Photo 6
Electrical