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Field Evaluation of Natural Gas and Dry Sorbent Injection for MWC Emissions Control

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EXECUTIVE SUMMARY

The Institute of Gas Technology (IGT), in cooperation with the Olmsted Waste-to-Energy Facility (OWEF) and with subcontracted engineering services from the Energy and Environmental Research Corporation (EER), has completed the detailed engineering and preparation of construction specifications for an Emissions Reduction Testing System (ERTS).

The ERTS has been designed for retrofit to one of two 100-ton/day municipal waste combustors at the OWEF, located in Rochester, Minnesota. The purpose of the retrofit is to conduct a field evaluation of a combined natural gas and sorbent injection process (IGT's METHANE de-TOX℠, IGT Patent No. 5,105,747) for reducing the emissions of oxides of nitrogen (NO_x), hydrochloric acid (HCl), oxides of sulfur (SO_x), carbon monoxide (CO), total hydrocarbons (THC), and chlorinated hydrocarbons (dioxins/furans). In addition, the design includes modifications for the control of heavy metals (HM). Development of the process should allow the waste-to-energy industry to meet the Federal New Source Performance Standards for these pollutants at signficantly lower costs when compared to existing technology of Thermal deNO_x combined with spray dryer scrubber/fabric filters. Additionally, the process should reduce boiler corrosion and increase both the thermal and power production efficiency of the facility.

The objective of Phase I, which has been completed and is the subject of this report, is to design the ERTS and prepare detailed construction specifications. The retrofit construction and testing would be carried out in Phase II and Phase III, respectively. The ERTS is composed of three major systems:

1. A flexible, dry, calcium/sodium-based sorbent injection system with sorbent storage, transport, metering, and injection subcomponents for the control of acid gases.

2. A flue gas humidification system for ESP performance enhancement to compensate for the increased particulate loading in the flue gases.

3. A dry, carbon-based, metal sorbent injection system with sorbent storage, metering, and injection subcomponents for capturing HM, specifically mercury, from the flue gases.

A natural gas injection system, which is also required, already exists at the OWEF as a result of an earlier retrofit of IGT's METHANE de-NOX℠ process. A field evaluation of this process verified that the addition of 15% natural gas lowers NO_x by 60% and CO by 50% while increasing system efficiency by 3%. This work was funded by GRI and a number of gas utilities. The retrofit represents a capital investment of $1.2 million, which is being made available to this program.

The new acid-gas sorbent system designed for METHANE de-TOX provides variations in size, type, injection location, amount, and mixing of the sorbents. The acid-gas sorbents to be tested include

the following three possible candidates: calcium carbonate (limestone), hydrated lime, and sodium bicarbonate.

The flue gas humidification system has been designed to provide a means to enhance the ESP operation, should the addition of sorbent impair its performance. It is accomplished by using a direct spray of atomized 10 to 20-micron water droplets into the flue gas ductwork. The water vaporizes and humidifies the flue gas.

The sorbent injection system for metals control has been designed to be a stand-alone system made up of a bag-breaker hopper connected directly to a volumetric screw feeder for dispersion of sorbent into flue gases. It also provides flexibility in size, type, and injection location of the sorbent. The selected sorbent is a lignite-based activated carbon.

Additional site modifications to support the ERTS installation include a new 125-hp air compressor, motor control center, and system control center, and integration of the ERTS control logic into the existing programmable logic controller platform.

It is estimated that Phase II efforts, consisting of procurement, construction, and system shakedown of the ERTS will require $2,839,500 and 12 months to complete. A 100-day operating period and a subsequent economic evaluation in Phase III will require $2,562,900 and 10 months to complete. This includes a $700,000 subcontract for analytical services in support of dioxin/furan sampling and analysis.

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INTRODUCTION

The Institute of Gas Technology (IGT), with funding support from the U.S. Department of Energy (DOE) through the National Renewable Energy Laboratory (NREL) and the IGT Sustaining Membership Program, and technical support from the Olmsted Waste-to-Energy Facility (OWEF), has completed the detailed engineering and preparation of comprehensive procurement and construction specifications for the field installation of a unique Emissions Reduction Testing System (ERTS).

The ERTS has been designed for addition to one of the two 100-ton/day municipal waste combustors at the OWEF, located in Rochester, Minnesota, in order to conduct a field evaluation of a combined natural gas and sorbent injection method (IGT's METHANE de-TOX^{SM} process, IGT Patent No. 5,105,747) to reduce emissions of oxides of nitrogen (NO_X), hydrochloric acid (HCl), oxides of sulfur (SO_X), carbon monoxide (CO), total hydrocarbons (THC), and chlorinated hydrocarbons (dioxins/furans). In addition, the design includes modifications for the control of heavy metals (HM). Development of the process should allow the waste-to-energy industry to meet the Federal New Source Performance Standards for these pollutants at signficantly lower costs when compared to the existing technology of Thermal deNO_X combined with spray dryer scrubber/fabric filters. Additionally, the process should reduce boiler corrosion and increase both the thermal and power production efficiency of the facility.

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The goals of this technology development program are to—

- Reduce the stack emissions as follows:

NO_X	Less than 80 vppm *
HCl	95% removal
SO_X	80% removal
CO	Less than 40 vppm *
THC	Less than 40 vppm *
Dioxins/Furans	Less than 5 ng/dscm

- Decrease corrosion in boiler, furnace, water walls, convective sections, ductwork, and pollution control equipment.
- Increase boiler thermal efficiency by 5% and overall power production efficiency by 10%, while controlling the stack emissions.
- Capture HM such as mercury, a common constituent in municipal solid waste (MSW) flue gas.
- Provide engineering analysis for comparison with alternative emission control technologies.

This report provides a comprehensive summary of the design and engineering effort.

The new acid-gas sorbent system designed for METHANE de-TOX provides variations in size, type, injection location, amount, and mixing of the sorbents. The acid-gas sorbents to be tested include the following three possible candidates: calcium carbonate (limestone), hydrated lime, and sodium bicarbonate.

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The sorbent injection system for metals control has been designed to be a stand-alone system made up of a bag-breaker hopper connected directly to a volumetric screw feeder for dispersion of the sorbent into municipal waste combustor (MWC) flue gases. It also provides flexibility in size, type, and injection location of the sorbent. The selected sorbent is a lignite-based activated carbon.

Additional site modifications to support the ERTS installation include a new 125-hp air compressor, motor control center, and system control center, and integration of the ERTS control logic into the existing programmable logic controller (PLC) platform.

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* All gaseous emissions, unless noted, are corrected to 7% O_2, dry basis.

TECHNOLOGY DESCRIPTION

The United States generates over 180 million tons of MSW each year, of which the majority is landfilled. About 29 million tons of MSW is, however, incinerated,[1] primarily in waste-to-energy facilities. Because of the increasing restrictions being placed on landfilling, the amount of MSW incinerated is expected to grow. By the year 2000, 24% of the MSW generated in the United States, which represents over 40 million tons/year of MSW and 4×10^{14} Btu's of energy, could be incinerated in MWCs. There are two major types of MWCs, that is, mass burn and refuse-derived fuel (RDF). These types differ primarily in the extent of waste preparation. The majority of the MWCs in the United States, currently in use or in the planning stages, are of the mass burn type.

Over the last 2 decades, significant advances have been made to make municipal waste combustion a cleaner and more controllable, as well as acceptable, alternative. However, waste-to-energy facilities, in many cases, still face stiff opposition – primarily because of concerns for the air pollutant emissions. Other problems facing the waste-to-energy industry include high-temperature corrosion of the boiler tubes and the superheaters,[2] and slagging and fouling.

To address the air emission concerns, the U.S. Environmental Protection Agency (EPA) is developing new air pollution rules that will apply to all new and existing MWCs. These rules will require MWCs to comply with emission limits for acid gases (HCl and SO_2), trace metals (measured as total particulates, Hg, Cd, and Pb), organics (measured as CO, PCDD, and PCDF), and NO_x. Table 1 summarizes the New Source Performance Standards for MWCs that were issued by the EPA in February 1991. These standards may be revised later under the 1990 Clean Air Act. Furthermore, local regulation (California, New Jersey, etc.) that is being placed on the MWCs, in many cases, requires significantly greater emission controls than those mandated by the Federal regulations. Strict emission controls are also being applied to MWCs in Europe[3] and Japan.

Technologies are commercially available, both in the United States and abroad, to control many of the air pollutant emissions– ESP or baghouses for particulates; selective noncatalytic reduction (SNCR) and selective catalytic reduction (SCR) for NO_x; and dry injection of lime slurry (dry scrubber), as well as wet scrubber, for acid gases. These technologies are, however, not free from drawbacks.

IGT is actively pursuing the development of alternate pollution control technologies for MWCs that are lower in cost and/or have fewer drawbacks. When fully developed, these technologies would also improve the performance of MWCs in terms of reduced CO emissions, increased system efficiency, reduced tube corrosion, and more stable operation.

Table 1. NEW SOURCE PERFORMANCE STANDARDS
(MWCs Over 250 ton/day)

	New Units	Existing Unit[c]
NO_x, vppm at 7% O_2	180	None
HCl[a] Removal, %	95	50
SO_2[b] Removal, %	80	50
CO, vppm at 7% O_2	100	100
THC	None	None
Dioxins/Furans, ng/dscm	30	125

a Or 25 vppm at 7% O_2.
b Or 30 vppm at 7% O_2.
c Up to 1100 ton/day.

NO_x Controls

As discussed, the SNCR and the SCR technologies for reducing NO_x emissions from MWCs, as well as other sources, have been commercially available for many years.[4,5] SNCR generally involves the injection of reducing agents, such as, NH_3 or urea, into the flue gases at temperatures of 1600° to 1900°F for 50% to 60% NO_x reduction, whereas SCR generally involves injection of NH_3 at temperatures of 500° to 800°F in the presence of a catalyst for even greater NO_x reductions. Both techniques, however, have several drawbacks.

- SNCR (using ammonia): High capital and operating costs, ammonia slip, ammonium chloride plume, requirement to store and handle pressurized toxic gas, increased particulate emissions, and potential for increased N_2O emissions
- SNCR (using urea): High capital and operating costs, ammonia slip, ammonium chloride plume, increased CO emissions, and potential for increased N_2O emissions
- SCR: Very high initial and operating costs, ammonia slip, flue gas reheating requirement, catalyst pluggage, and spent catalyst disposal.

It was believed that a technology based on natural gas could overcome many of the drawbacks, while also offering certain benefits. Figure 1 illustrates the concept selected for MWCs. Termed METHANE de-NOX, it involves the injection of natural gas, together with recirculated flue gases (for mixing), above the grate to provide reducing combustion conditions that promote the destruction of NO_x precursors, as well as NO_x. Secondary overfire air (OFA) is then injected at a higher elevation in the furnace, after sufficient residence time at these reducing conditions, to burn out the combustibles.

A program was undertaken to assess and develop the concept. The development steps were 1) characterization of the in-furnace conditions of a commercial MWC to define the variability of operation, the gas temperatures within the furnace, and the distribution patterns for oxygen, CO, NO_x, and other flue gas species; 2) evaluation of the gas-phase chemistry in laboratory furnace simulation experiments 1.7 X 10^6 Btu/h to define the regions of operation in which METHANE de-NOX could be

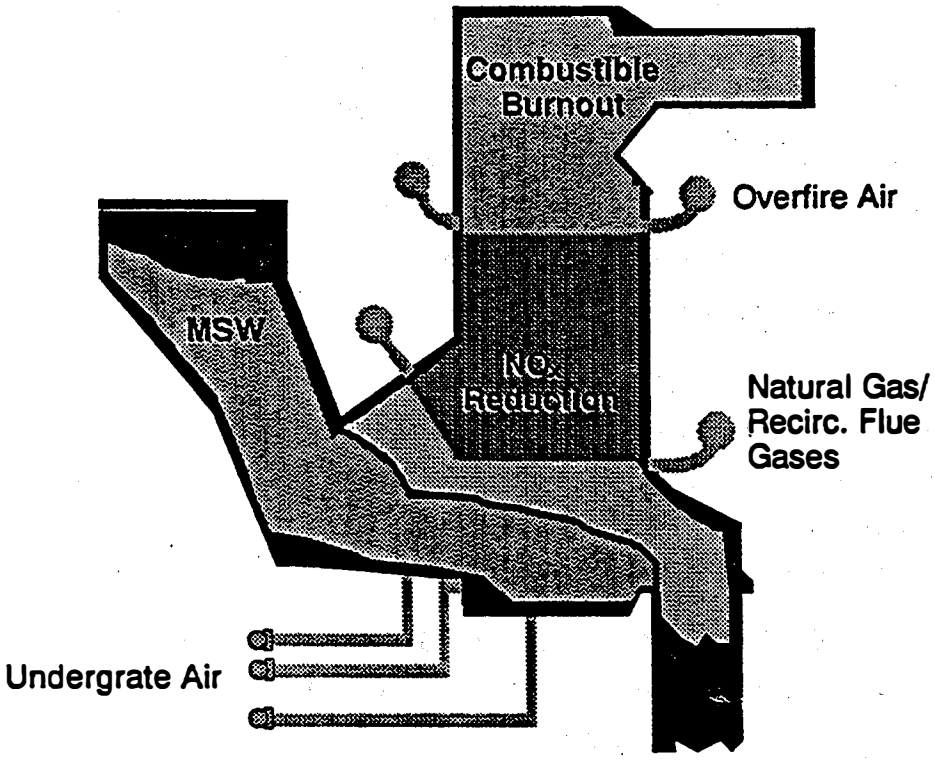

Figure 1. THE METHANE de-NOX PROCESS

effective; 3) design and construction of a pilot combustor 2.5 X 10^6 Btu/h firing actual MSW, in which the METHANE de-NOX process could be developed and tested; and 4) a full-scale evaluation of the process on a commercial MWC.

The baseline data were acquired on one of the two units at the Olmsted County Waste-to-Energy Facility (Figure 2) located in Rochester, Minnesota. The design of the combustor is an integration of the Takuma MWC stoker and combustion control technology with the Riley waterwall furnace technology. Each unit is designed to burn MSW at the rate of 100 ton/day, producing about 24,000 lb/h of 615-psig superheated steam. Test details and results have been presented earlier from the commercial combustor characterization, as well as the pilot-scale efforts.[6,7,8] Briefly, the baseline data confirmed the possibility for creating the desired NO_X reducing conditions within the furnace. The results of pilot-scale assessments showed that 10% to 15% (percent of total heat input) natural gas reduced NO_X emissions by as much as 70%, depending on the natural gas and OFA injection points and the residence time in the reducing zone.

Development Status of METHANE de-NOX

In light of the favorable test results obtained from both the IGT and Riley pilot-scale investigations, a field evaluation was undertaken at the OWEF. The primary goal was to reduce NO_X to below 110 vppm from the current uncontrolled level of over 220 vppm without adversely affecting other emissions, such as CO and THC. Additional goals were to maintain or increase the steam capacity and the boiler thermal efficiency.

The retrofit METHANE de-NOX system was designed based on the pilot-scale results. It included installation of an FGR system and modification of the furnace walls to accommodate several nozzles and sampling/observation ports at multiple levels. The design also provides for acquisition of the necessary in-furnace and flue gas composition and temperature data, as well as other relevant data. Recirculated flue gas, taken from the economizer outlet, is used to introduce natural gas above the grates. OFA injectors are installed in two locations in the upper half of the furnace for combustible burnout. The two elevations enabled testing of different residence times for the reducing zone. Residence time has a significant effect on NO_X reduction and combustible burnout. Inserts were employed during the testing to evaluate different injection velocities for the OFA, natural gas, and FGR. The system was instrumented to provide an extensive data base for the impacts of METHANE de-NOX on both the furnace side, as well as the steam side parameters. The results presented here will focus on NO_X and CO emissions measured at the ESP inlet and their relationships with some of the significant operating parameters.

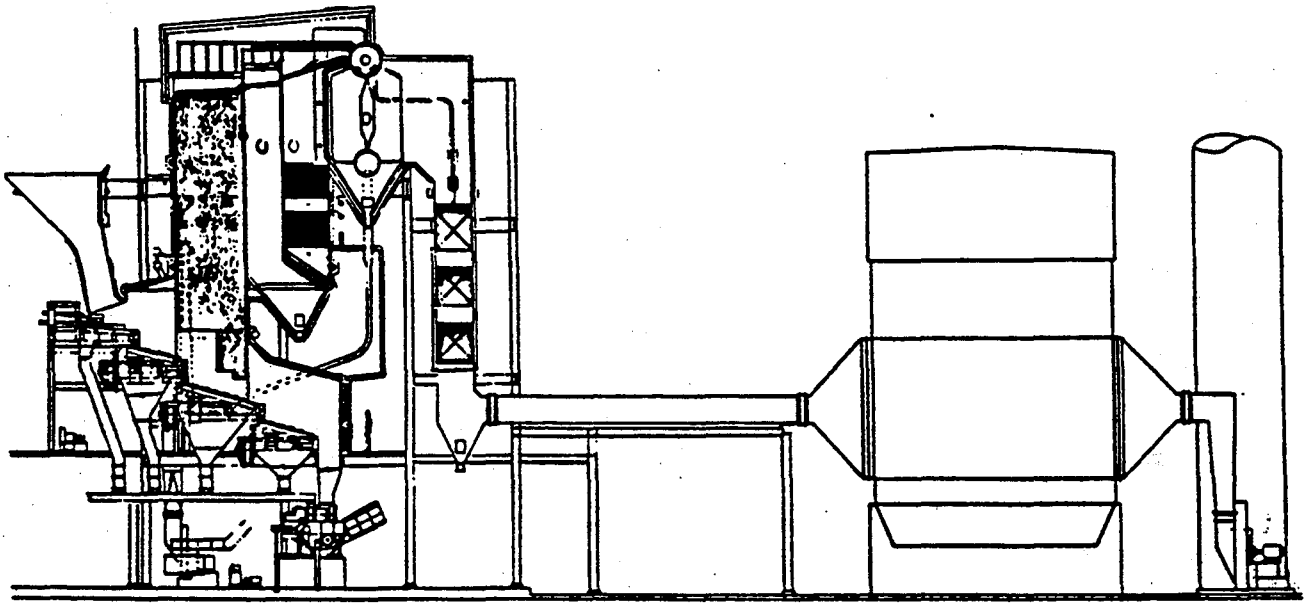

Figure 2. OLMSTED WASTE-TO-ENERGY FACILITY

Table 2 summarizes the average values of selected operating data, as well as CO and NO_x emissions from the field evaluation tests. Data are also presented from the 1987 baseline tests and for one test with METHANE de-NOX that was carried out at a higher steam flow to maintain the MSW rate at the current normal baseline value of 1432 lb/h. It must be noted that the steam flow during the 1991 baseline test was about 28,250 lb/h or 6% higher than the current normal baseline steam flow of 46,000 lb/h, and 20% higher than the 1987 baseline level of 23,500 lb/h. During most of the tests with natural gas injection, the steam flow rate was maintained between 28,160 and 29,000 lb/h or 9% higher

Table 2. AVERAGE OPERATING DATA – 1990/1991
FIELD EVALUATION TESTS

	Baseline			FGR at Normal 1987 Baseline MSW Input	NGas at Normal 1991 Baseline MSW
	1987 Test	1991 Test	FGR Only	(Avg. Data)	Input Test
MSW,* lb/h	6,450	7,900	7,350	6,650	7,100
Natural Gas, %	0	0	0	14.8	12.9
Total Heat Input,* 10^6 Btu/h	33.5	41.2	38.6	40.5	42.5
FGR, %	0	0	7.9	8.7	10.6
Total Fuel Gas, lb/h	46,000	59,000	46,000	48,000	45,400
Steam Flow, lb/h	23,500	28,250	27,300	28,600	30,500
Economizer Exit Temperature, °F	417	425	430	422	422
Precipitator Inlet O_2, %	9.3	10.5	8.9	6.5	5.9
CO, vppm, at 7% O_2	47	72	100	35	33
NO_x, vppm, at 7% O_2	210	185	150	75	75

* Estimated.

than the current normal baseline level (as there was no need for the additional steam), which automatically decreased the MSW feed rate to the 1987 baseline value. However, as shown, one test was carried out with the MSW rate maintained very close to the current normal baseline level by increasing the steam flow by about 14%. This was to prove that METHANE de-NOX retrofits do not necessarily require a decrease in MSW feed rate. Table 2 shows that 13% to 15% (total heat input) natural gas injection allowed a reduction in excess air from over 100% (10.5% excess O_2) to about 50% (6.5% excess O_2), which as discussed later, allows a higher firing rate and increases the boiler thermal efficiency.

The data presented in the table also show that compared to the 1991 baseline test, METHANE de-NOX decreased the NO_X emissions by about 60% and CO emissions by about 50%. The NO_X emissions were decreased by 20% with FGR alone, however, the CO emissions were more than double compared with the average CO with METHANE de-NOX.

Figure 3 illustrates the relationship between NO_X and CO emissions for the Olmsted combustor that was found in 1987 for the baseline operation. The data represent operation at different air flow distributions and excess air levels. The current (1991) baseline data appear to follow the 1987 baseline trend. The data with natural gas injection in the nonoptimum configurations show considerable scatter; but in general, some show NO_X and CO reduction. On the other hand, the data with the optimum METHANE de-NOX configuration and with 12.5% or higher natural gas injection, illustrated by solid triangles, distinctly show a significant reduction in both NO_X and CO emission levels. The average baseline NO_X at 50 vppm CO (expected regulatory limit) was about 215 vppm, while the average NO_X with METHANE de-NOX was about 80 vppm at an average CO level of 35 vppm.

Figure 4 illustrates that by decreasing the oxygen concentrations in the secondary zone NO_X emissions decreased. The figure shows that proper injection of natural gas can significantly reduce NO_X without requiring highly fuel-rich conditions in the oxygen deficient zone.

Figure 5 further illustrates the importance of employing proper natural gas, FGR, and overfire air injection strategy. Employment of optimum strategy– FGR injection configuration 2, natural gas injection configuration 1, and the higher elevation OFA injection– provided the lowest NO_X values. Although not shown, the CO levels were also lowest with the optimum injection strategy. In this configuration, there appears to be a slight decrease in NO_X upon increasing the natural gas level. The CO level, not shown, also decreased with increasing natural gas– more so than NO_X .

Injection of natural gas was anticipated to increase the boiler thermal efficiency because of the reduction in the overall excess air level. As shown in Table 2, the gas temperatures measured at the economizer exit with METHANE de-NOX were comparable to the baseline levels, which when combined with the reduction in excess air levels when using METHANE de-NOX, should translate into a higher system thermal efficiency. As shown in Figure 6, the efficiency increased from a baseline value of 72.4% with no natural gas, to 74.1% with 9% natural gas injection, and to 75.0% with 13.5% natural gas injection.

Acid-Gas Controls

As discussed, wet and dry scrubbing technologies to control acid-gas (HCl and SO_2) emissions from coal, as well as MWCs combustors, have been commercially available for some time. Wet scrubbers are most common in Germany and Switzerland, while dry and semi-dry (hybrid) scrubbers are popular in North America and Scandinavian countries.[3] These technologies are very effective in

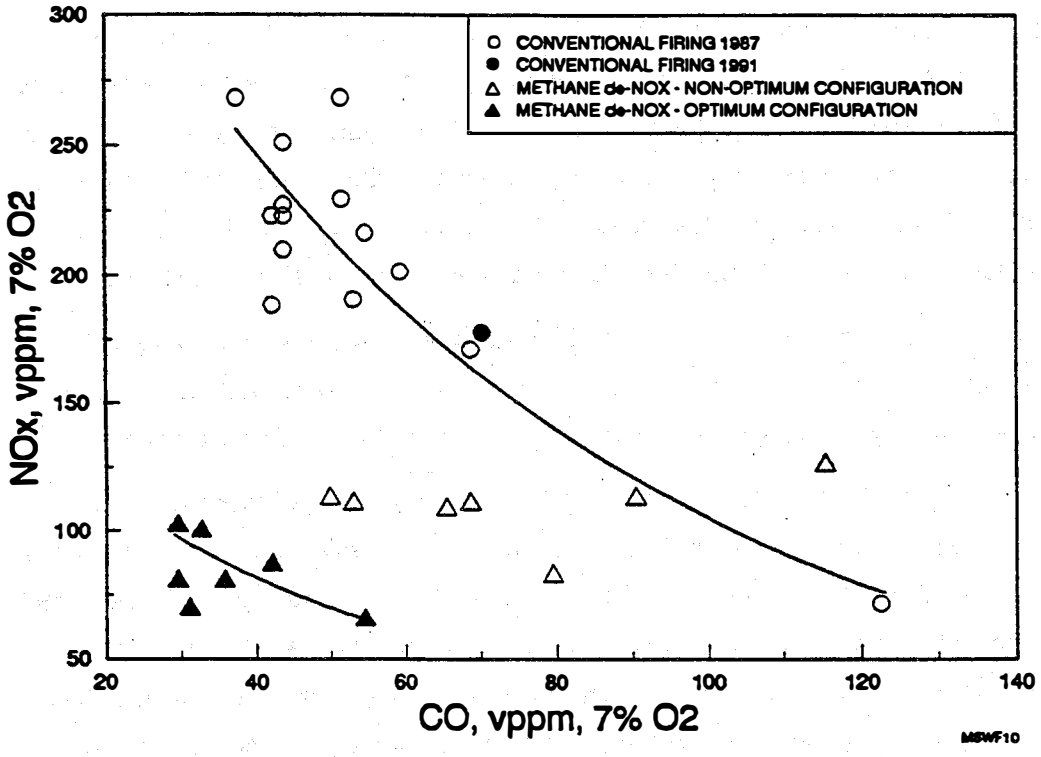

Figure 3. NATURAL GAS INJECTION SIMULTANEOUSLY DECREASES NO_X AND CO EMISSIONS

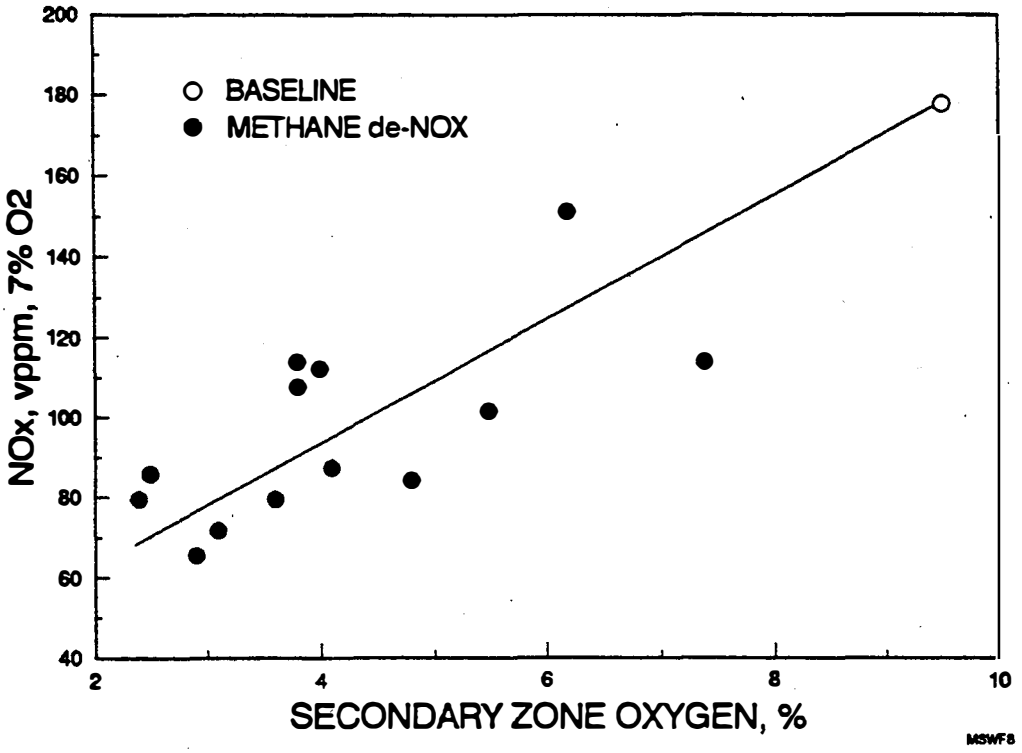

Figure 4. EFFECT OF REDUCED OXYGEN CONCENTRATION ON NO_X FORMATION

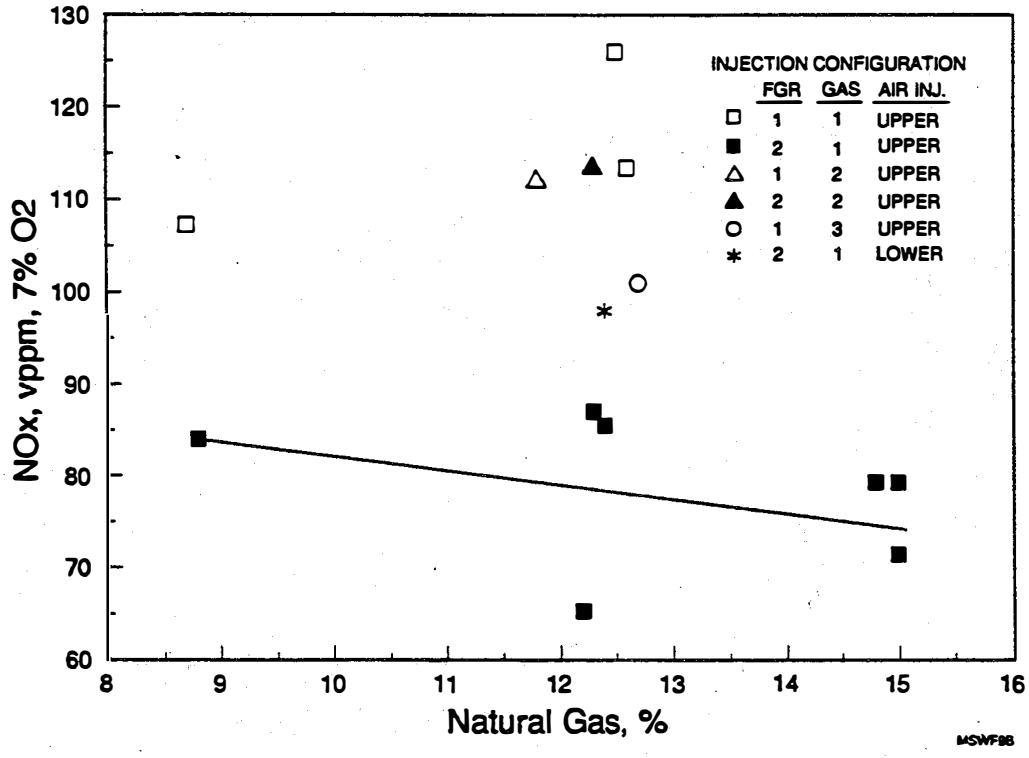

Figure 5. PROPER NATURAL GAS AND FGR INJECTION STRATEGY IS CRITICAL

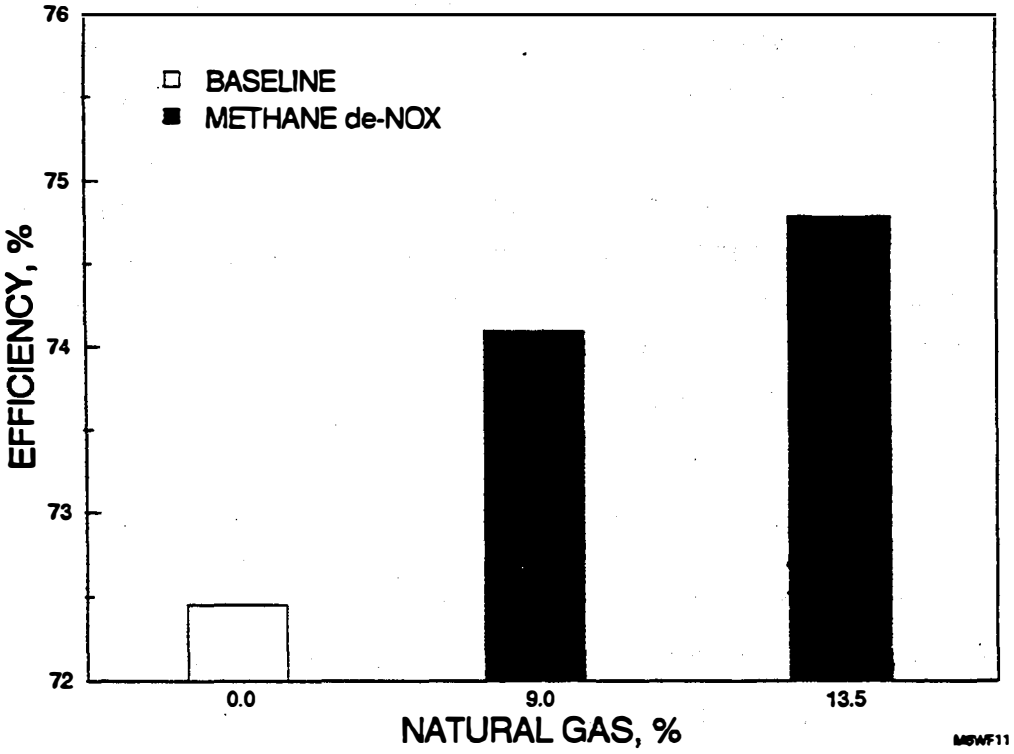

Figure 6. NATURAL GAS INJECTION INCREASES SYSTEM THERMAL EFFICIENCY

controlling both SO_2 and HCl – reducing them by over 90% and 95%, respectively. In the dry injection system, which is the most common in the United States, a lime slurry is sprayed into the flue gases in a relatively large chamber, where HCl and SO_2 react with the lime to produce chloride, sulfate, and sulfite of calcium. The water in the slurry evaporates, dropping the flue gas temperature to below 300°F, and producing dry solid fly ash particles containing the calcium salts. A detailed discussion of this type of scrubber is provided in Reference 9. As discussed earlier, both wet and dry scrubbers are fairly high in capital as well as operating costs. A cheaper alternative, if effective, would be to inject dry, powdered sorbent into the flue gas duct or directly into the furnace. A number of investigations have been carried out to evaluate this technique, differing primarily in the injection location.

The EPA's Air and Energy Engineering Research Laboratory (AEERL) began development work in the 1970's on furnace and duct injection of alkaline-based sorbents for control of SO_2 emissions from utility and industrial boilers. These efforts have culminated into a full-scale demonstration of a furnace and duct injection system on a coal-fired utility boiler at Ohio Edison's Edgewater plant. Based on their work, AEERL has reported[10,11] the following findings:

- Both $CaCO_3$ and $Ca(OH)_2$ convert rapidly to CaO under furnace conditions.
- SO_2 reduction is determined by the reactivity of CaO produced.
- Maximum sorbent reactivity and sulfation occurs at 1600° to 2300°F.
- CaO reactivity increases with surface area, particle size, and pore size.
- CaO produced from $Ca(OH)_2$ has better surface area for SO_2 capture.
- Optimum temperature for $Ca(OH_2)$ injection is 2280°F.
- Deposits formed in the furnaces high-temperature zone are soft and removable.
- Sorbent injection increases ash resistivity, which can be restored by flue gas humidification.
- Humidification also improves SO_2 capture.

Some of the other work being carried out on dry sorbent injection in coal-fired boilers is described in References 12, 13, and 14.

Furnace injection of alkali sorbents in MWCs to control HCl, SO_2, as well as organics, has also been under investigation. AEERL has carried out bench- and pilot-scale research to investigate PCDD/PCDF formation mechanisms and evaluate sorbent injection for chlorinated organic removal. In these investigations, gas phase Cl_2 formed from the Deacon process reaction has been found to be a likely chlorinating agent for PCDD/PCDF formation.[15] It has been postulated that furnace or duct injection of calcium-based sorbents can effectively control PCDD/PCDF formation reactions. Bench-

and pilot-scale studies have also been conducted by AEERL to evaluate the effectiveness of dry injection of $CaCO_3$, CaO, and $Ca(OH)_2$ in controlling HCl and SO_2 emissions. The most effective sorbent was found to be $Ca(OH)_2$, followed by CaO and $CaCO_3$. Proof-of-concept testing on the use of dry sorbent injection has been completed at the Montgomery County W-T-E (Waste-to-Energy) facility.[16] In this work, in-furnace injection of $CaCO_3$ was not found to be effective. The lowest emissions were achieved during tests, in which $Ca(OH)_2$ was injected into the duct just upstream of the ESP. It was also concluded that reduction of ESP temperature decreases stack PCDD/PCDF, and that PCDD/PCDF also formed in the combustor due to incomplete combustion (it is commonly believed that PCDD/PCDF are primarily formed on ash particles at temperatures below 700°F). Exploratory tests of furnace lime injection has been carried out at the Bay County, Florida, W-T-E facility.[17] In this case, the sorbents (45 micron $Ca(OH)_2$, 640 micron quick lime, and 1600 micron $CaCO_3$) were fed with MSW through the feed hopper opening. $Ca(OH)_2$ was found to be most effective for acid-gas control. It removed 60% to 88% SO_2 and 25% to 76% HCl. No loss in the ESP efficiency was noted.

In-furnace sorbent injection has also been employed by other incinerator manufacturers, notably Ogden Martin Systems and Takuma Company Ltd.

Development Status of METHANE de-TOX (METHANE de-NOX Combined With Sorbent Injection)

Figure 7 illustrates the METHANE de-TOX concept that combines METHANE de-NOX with in-furnace injection of sorbents for the simultaneous reductions in the emissions of NO_x, HCl, SO_2, CO, THC, PCDD, and PCDF. In this approach, sorbents are injected directly into the oxygen-deficient zone together with natural gas and recirculated flue gases, and the sorbents are thoroughly mixed with the products of MSW combustion. Similar to METHANE de-NOX, OFA is injected into the combustion products near the furnace exit to burn out the combustibles. Because the sorbents are injected into the lower furnace, the residence time available for calcination and reactions of the sorbent with H_2S, SO_x, and HCl is increased. Compared to conventional MWCs, where the relatively nonuniform temperatures can either sinter or slow down the calcination of the sorbents and reduce their activity, the METHANE de-TOX approach provides faster calcination and sulfation. Furthermore, by injecting OFA at a relatively high location, the residence time in the oxygen-deficient zone is maximized for H_2S, SO_x, and HCl removal reaction, and NO_x and NO_x precursor decomposition. Sufficient OFA is injected to complete the combustion of CO, H_2, and THC, and to oxidize H_2S to SO_x, and CaS to $CaSO_4$. The reactions of SO_x and HCl with residual CaO will continue above this OFA injection zone. As the gases leave the furnace and are cooled below 1700°F, the SO_x removal will begin to diminish, while HCl removal will continue to increase. Reduction of flue gas HCl and SO_x concentration by as much as 95% and 90%, respectively, is theoretically possible, depending on the residence time, the sorbent particle size, and the concentration of water vapor in the flue gases.

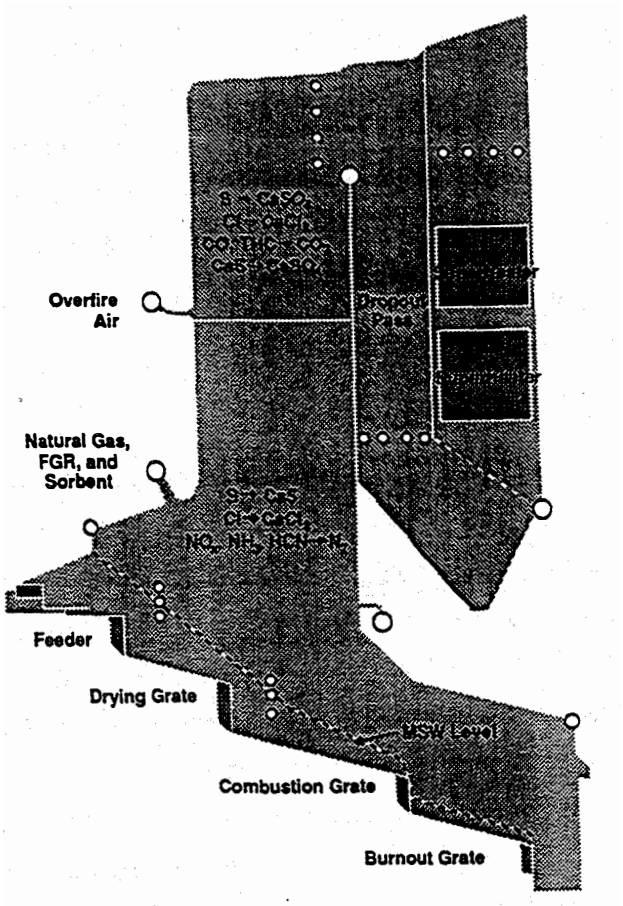

Figure 7. THE METHANE de-TOX PROCESS

Exploratory tests at the Bay County W-T-E facility by simply adding the sorbent to the MSW have shown the potential for significant HCl and SO_2 reductions up to 76% and 88%, respectively, at certain conditions. The reductions were, however, widely variable with time. Others, including Ogden and Takuma, are believed to have had similar results with somewhat different injection schemes.

The results reported by others led IGT to believe that significantly better performances can be expected with METHANE de-TOX. The reasons are as follows:

- It is important to match the sorbent injection to the furnace acid-gas profile, properly distribute and mix the sorbent, and inject it into the furnace to maximize calcination and minimize sintering. None of these factors, to IGT's knowledge, have been employed in the current efforts. In almost all cases, the sorbent is believed to have been injected either with the MSW or through the available ports either with the OFA or separately. These injection schemes are not conducive to promoting optimum calcination or reactions between the sorbent and the acid gases. In METHANE de-TOX, sorbents will be injected at the optimum furnace temperature zone and their distribution and mixing will be optimized to match the acid-gas concentration profiles.

- METHANE de-TOX utilizes natural gas injection, which has been shown to improve the temperature and composition uniformity in the furnace. This should enhance the calcination efficiency and minimize sintering.

- In METHANE de-TOX, smaller (3 to 5 microns) sorbent particles will be used, if required, to significantly increase acid-gas, especially HCl, capture.

- In METHANE de-TOX, natural gas injection allows the excess air to be reduced from over 100% to below 50%, which will increase the base concentrations of the acid gases and increase the sorbent residence time both, in the higher temperature zones to enhance H_2S and SO_2 removal, and in the lower temperature zones to enhance HCl removal.

Furnace injection of sorbents also provides another important benefit. It removes the acid gases in the high-temperature furnace zones to reduce the boiler tube as well as superheater surface corrosion. It may be possible to increase the steam superheat temperature and decrease the boiler flue gas temperature with this approach, to provide a higher power production efficiency.

TASK DESCRIPTION

In order to accomplish the program objectives, the scope of work for the ERTS design and engineering was structured into five major tasks:

- Task 1. System Definition: Conduct preliminary engineering studies to develop basic design data and sizing guidelines. Determine equipment for the dry acid-gas and dry metal sorbent injection systems. Evaluate and design possible humidification arrangements through design studies.

- Task 2. Detailed Design: Assemble complete system design details suitable for construction, consisting of design diagrams, engineering drawings, and installation details for the ERTS equipment, structural, mechanical, electrical, instrumentation, and control requirements.

- Task 3. Safety Analysis Study – HAZOP Report: Conduct a safety analysis and provide a report reviewing the ERTS process flow scheme along with associated equipment and controls, as designated in the detailed design. Specify worker safety and environmental provisions needed for the proper handling of microfine particulates.

- Task 4. Major Equipment Quotations: Develop sizing criteria and specifications for all major equipment and instrumentation, as identified in the detailed design. Obtain competitive vendor bids and provide an installed cost estimate utilizing a third-party software package.

- Task 5. Construction RFQ Package: Develop a specification manual for the material procurement and equipment installation of ERTS.

TASK 1. SYSTEM DEFINITION

In Task 1, engineering studies were conducted to finalize the design basis for ERTS. Factors assessed for the dry sorbent injection system design included equipment selection, sizing, system arrangement, operator safety, long-term reliability, bulk shipment quantities, and ease of operation. Humidification concerns addressed were non-wetting of the interior surfaces, rapid evaporation, atomizing medium requirements, and continuous reliable operation.

Basic Design Data

Performance Criteria

Based on process needs and desired goals in support of parametric field evaluation tests (see Appendix A for the test matrix), the following criteria governing the performance of ERTS were established:

- The acid-gas sorbent demand will be based on a 2:1 (by weight) ratio of Ca to combined S and Cl contents. The total maximum sorbent injection rate will be 300 lb/h, with a nominal operating range of 200 to 300 lb/h. Sorbent will be evenly divided among injection ports.
- Four different levels for acid-gas sorbent injection will be provided to evaluate the effects of available residence times, furnace temperatures, and combustion stoichiometry on the effectiveness of the sorbents. Level 1 consists of 9 ports. Levels 2 and 3 contain 12 ports each. Level 4 has four ports.
- The acid-gas sorbent storage, transport, metering, and injection systems must be capable of handling three different sorbents (limestone, hydrated lime, and sodium bicarbonate).
- The size of the bulk acid-gas sorbent silo should be sufficient to store a minimum of 7 days requirement. In addition, the transport system size should be adequate to serve both OWEF boilers, Units 1 and 2, at 300 lb/h each.
- The metal sorbent injection rate will be 5 lb/h. Metal sorbent will be lignite-based activated carbon. It will be injected through a single injection port, downstream of system economizer.
- Humidification will utilize OWEF noncontact cooling water. Compressed air will be used for spray atomization. Control of flue gas moisture will assure noncondensing conditions in the ESP and the stack. The humidification design will be based on a saturation approach temperature of 70°F.
- To the maximum extent possible, both the design of the equipment and the methods of installation should be consistent with a 20-year plant life.

Material Balance

A baseline material balance developed for IGT's METHANE de-NOX process served as the basis for determining the material flows expected with ERTS. Engineering calculations were carried

out and the material balance revised, incorporating sorbent injection and humidification, as shown in Appendix B. The material balance is based on an MSW feed rate of 90 tons/day, which is the current baseline value. The facility operates at this lower rate instead of the nominal rate of 100 tons/day because of the higher-than-design heating value of OWEF's feed (currently 6000 Btu/lb). Acid-gas sorbent usage determined at this base-load condition is expected to range up to 300 lb/h. Actual flow for each acid-gas sorbent will be determined based on a 2:1 ratio of Ca to combined S and Cl amounts. The quantities shown in the material balance represent nominal design conditions on which the major equipment specifications and detailed design is based.

Metal sorbent usage recommendations were provided by the U.S. EPA. The humidification system material balance is based on the following flue gas conditions:

Temperature at the Economizer Outlet	475°F
Mass Flow Rate	47,000 lb/h
Moisture Content	15-20% by weight

From these data, calculations were performed, using custom computer codes. The results indicate that 5.9 gpm of water will be required to cool the flue gases to 70°F above saturation. Flue gases humidified to this level are expected to significantly improve the ESP performance. Past experience, that has been reported, shows that, even at humidification approach temperatures of 120°F above saturation, enhanced ESP operation is probable. The saturation temperature for a flue gas with 15% moisture by weight is approximately 155°F.

Process Flow Diagram

Depicted in Appendix C is the ERTS process flow diagram (PFD). Major process flows and equipment requirements are illustrated. Acid-gas sorbents consisting of high calcium carbonate limestone, hydrated lime (calcium hydroxide), and sodium bicarbonate are to be delivered in bulk shipment via blower-equipped tanker trucks. The selected sorbent is then transferred into a 50-ton storage silo. From the silo, sorbent is conveyed in a dense phase, full-line concept transport system connected to 13 different feed hoppers, as required for parametric field evaluation testing.

The hoppers are connected directly above volumetric feeders. Regulation of the sorbent into the MWC is accomplished by variable DC motor speed drives controlling the screw's rpm. Speed control is accomplished by the transmission of electronic signals from an existing PLC and operator display control center installed during the METHANE de-NOX modification.

Sorbent discharged from the feed screw drops by gravity into a solids/gas eductor manufactured by FOX Valve Development Co. The eductor entrains the sorbent in a stream of compressed air. The solid-gas mixture is conveyed using flexible hoses in a dilute phase flow regime to dedicated injection

nozzles in OWEF's existing MWC Unit No. 1. EER's prior experience with using flexible hoses for sorbent conveying shows reduced plugging tendencies, while providing system flexibility and ease of field installation. Four different injection levels, identified as Levels 1, 2, 3, and 4, on the PFD, will be investigated during field evaluation testing.

The humidification system is incorporated into the ERTS to provide a means to enhance the ESP operation, should the addition of sorbents impair its performance. Air-assisted atomizers spray 10 to 20-micron water droplets directly into the flue gas ductwork through two humidification lances. The water vaporizes and humidifies the flue gas. Humidification control is provided by using the feedback from temperature sensors located downstream of the lances and upstream of the ESP. Due to existing system design constraints, the atomizers need to be custom-designed to provide the desired level of atomization. The desired water droplet diameter is 12 microns.

The metals capture system injects a dry carbon-based sorbent into MWC flue gases downstream of the economizers. The designated sorbent is a lignite-based activated carbon material. Delivered in 50-pound bags, the sorbent is manually loaded into a dedicated bag-breaker hopper station complete with an exhaust blower and a vent filter to control dusting. A volumetric screw feeder connected to the hopper outlet controls the injection rate similar to the method described above. The metal sorbent is to be injected into the ductwork downstream of the economizers and the flue gas take-off for the FGR system. A single injection nozzle will disperse the sorbent into the flue gas.

Development of the PFD required a concerted effort from IGT, EER, and Mr. R. Dunnette, OWEF's plant manager. The proposed scheme should provide a reliable testing platform for future parametric field evaluation tests.

Sorbent Descriptions

Acid-Gas Sorbents

Acid-gas sorbents used in the design basis and proposed for field testing include:

Type	Formula
Limestone	$CaCO_3$
Calcium Hydroxide	$Ca(OH)_2$
Sodium Bicarbonate	$NaHCO_3$

For these three sorbent types, IGT has selected the following suppliers:

Limestone

J. M. Huber Corp.
Carry Co. (Distributor)
Addison, IL
Attn: Carl Hopf or Jim Foy
708-629-6600

Product: Hubercarb W4

Calcium Hydroxide

Linwood Mining & Minerals Corporation
Davenport, IA
Attn: Tom Bush
319-359-8251

Product: Atmospheric Hydrate

Sodium Bicarbonate

Church & Dwight Co.
Princeton, NJ
Attn: Art Esposito
800-526-3563

Product: Sorbent Grade Xtra Fine

Acid-Gas Sorbent Properties:

Composition (wt %)	Limestone	Hydrated Lime	$NaHCO_3$
$CaCO_3$	99.25	1.5	
$MgCO_3$	0.3		
$Ca(OH)_2$		92.0	
$NaHCO_3$			98.5
MgO			1.0
Al_2O_3			0.8
Iron (Fe_2O_3)			0.5
CaO			1.0
Silicates	0.05	1.0	
Moisture	0.05	0.5	0.5
Inerts	0.35	1.7	1.0
Bulk Density (lb/ft^3)			
Loose	55	27	40
Compacted	60	40	54

Metal Sorbent

The metal sorbent used in the design basis was selected based on recommendations from the U.S. EPA. The selected material is a lignite-based activated carbon sorbent to be supplied by:

American Norit Company
Atlanta, GA
Attn: Robert Edwards
404-512-4610

Product: Darco FGD (Lignite based)

Metal Sorbent Properties:

Composition (wt %)	Act. Carbon
Activated Carbon	90-100
Moisture	5-10
Bulk Density (lb/ft^3)	
Loose	20
Compacted	35
Size Distribution (μm)	
Mean Particle Size	15-25
% Greater Than	
150 microns	1
70 microns	2-3
40 microns	5-10
1 microns	95

Codes and Regulations

The ERTS design drawings and related specifications adhere to applicable industrial design codes and pertinent governmental rules and regulations. The standards followed are listed below:

AISI American Iron and Steel Institute, "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings" effective November 1, 1978

Minnesota State Building Code, 1990, Minnesota Rules Chapters 1300, 1301, 1302, 1305, 1310, 1315, 1330, 1335, 1340, 1350, 1360, 1365, and 1370

AISC American Institute of Steel Construction

UBC Uniform Building Code, 1991, Sections 2906, 2907, and 2910

ACI American Concrete Institute, Building Code Requirements for Reinforced Concrete, ACI-318-89 and ACI-318R-89, Chapter 9, Strength and Serviceability Requirements

ANSI American National Standards Institute, B31.1-1986 Piping and Valves Design and Selection

Minnesota Plumbing Code, 1990, Chapter 4715

	U.S. Federal Occupational Safety and Health Standards
ASTM	American Society for Testing and Materials, Materials of Construction
AWS	American Welding Society, Code AWS D1.1-88
ISA	Instrument Society of America, Instrument Design Code
NEMA	National Electrical Manufacturers Association
UL	Underwriters Laboratories, Electric Safety Testing Code
FM	Factory Mutual System
NEC	National Electric Code, 1990
ANSI	ANSI-C-2 National Electric Safety Code
ANSI	ANSI-C-37 Electric Power Control Equipment Standards
ANSI	ANSI-C-57 Electrical Power Transformer Standards
	City of Rochester, Building and Safety Department
	OWEF Specifications: Section 15047 Power Plant Piping, Section 15260 Piping Insulation, Section 15482 Instrument Air Piping, and Section 15880 Air Distribution System
ASME	American Society of Mechanical Engineers, Boiler and Pressure Vessel Code 1989 and all addenda

In addition, OWEF's insurance underwriter, Factory Mutual System, received design information for comments. Prior to construction, Rochester's Building and Safety Department must review and approve the mechanical, electrical, and structural design drawings and specifications. All drawings and specifications, as required by the state law, require a stamp by an engineer licensed in the State of Minnesota.

Design Concerns

Injection Air

As previously discussed, venturi solid/gas eductors were selected for introducing the acid-gas sorbents into a gas stream in a dilute phase conveying system. Contact with Fox Valve Development Company, the eductor manufacturer, established the venturi size and air requirements necessary to convey sorbents to the furnace. The 1-inch size recommended by Fox requires an air flow of 18 to 22 SCF/min; therefore at Levels 2 and 3, 12 injectors introduce a total air flow of approximately 240 SCF/min or 1100 lb/h into the combustion products. This added air flow into the upper furnace areas is not expected to significantly impact the performance of the IGT METHANE de-NOX process.

Injection Level 1 is in the oxygen-deficient zone that is created in the METHANE de-NOX process for NO_X reduction. The addition of air introduced here may significantly impact NO_X reductions. Additional air may also result in increased natural gas flow requirement to maintain the oxygen-deficient levels in the lower furnace, desired for NO_X reductions. After a preliminary estimate, it was decided that the amount of air introduced at Level 1 should be minimized.

In order to minimize the amount of air introduced at Level 1, it was decided to use fewer volumetric feeders to supply the sorbent to several ports by utilizing line flow splitters. With this arrangement, air flow was significantly reduced. Flow splitters are reported to have been used successfully in the past. The ERTS design incorporates 4-way and 2-way flow splitters. With this arrangement, the air flow rate to Level 1 is not expected to exceed the desired value. This will require some adjustments to the process to achieve maximum NO_X reduction.

Calcium Hydroxide -- Material Handling

In system definition work, it became apparent that, of the three possible sorbents to be handled, calcium hydroxide is the most difficult. It naturally tends to stick, cake, and pack if left over extended stagnant periods. Moisture further aggravates these characteristics.

Given the design criteria and the physical limitations of available space in the boiler area, a dense phase transport system was selected initially to distribute the sorbent to the individual feeders. Later studies discovered only a limited number of dense phase systems in operation; however, leading sorbent transport system vendors identified successful applications, but stressed that actual material testing should be conducted to determine final design and system operating parameters. Testing is a prerequisite cited in the procurement description, not only for the transport system but also for the volumetric feeder manufacturers.

Fox Valve Development Corporation also reported operating difficulties with handling hydrated lime and made several recommendations. Spare eductors should be on hand and eductor installation details should permit easy access and removal. Plugged units can be cleaned onsite in a sonic bath of cleaning solution (1% to 2% vinegar) and used again. How much maintenance the system may require is uncertain; only through actual experience can it be determined. In addition, Fox asked that a straight run of piping (10 to 15 diameters) be maintained from the eductor discharge. The ERTS design incorporates these recommendations.

TASK 2. DETAILED DESIGN

In this task, detailed engineering and design work was carried out based on data developed in Task 1, System Definition. System drawings were generated to describe the details necessary for defining the ERTS construction and integration requirements at the host site. A list of selected engineering drawings and specifications that were completed is shown below. Appendix D contains a complete list of the extensive number of drawings generated to fully describe and specify the ERTS retrofit to OWEF.

- Process flow diagram with material balance
- Utility flow diagram quantifying all utility needs
- Piping and instrumentation diagrams showing all piping, instrumentation, and equipment details
- Site plan with site preparation considerations
- Plot plan and equipment arrangement plans
- Major equipment specifications
- Foundation and structural design drawings
- Process piping layout diagrams with plan and elevation views
- Utility piping layout diagrams
- Materials of construction shown and identified on drawing
- Electrical power distribution, single line diagram
- Electrical circuit and cable listing
- Electrical raceway routing diagrams
- Instrumentation specifications
- Bill of materials for major equipment, instruments, valves, piping, and insulation
- Detailed procurement and construction schedule.

ERTS Piping and Instrumentation Diagrams

Four P&ID diagrams illustrate the ERTS METHANE de-TOX process, equipment, piping, and instrumentation (see Appendix E). These are as follows:

Drawing No.	Description
P8731E-002, Sheet 1	Compressed Air Supply and Distribution
P8731E-002, Sheet 2	Acid-Gas Sorbent Material Handling and Transport
P8731E-002, Sheet 3	Acid-Gas Sorbent Material Handling and Transport
P8731E-002, Sheet 4	Metal Sorbent and Humidification Systems

Next to the PFD these diagrams are essential elements in the detailed design effort. System descriptions are provided below.

Acid-Gas SorbentHandling

Sorbents will be delivered to the site by pneumatic trucks and stored in a single silo, SIL-101. The silo has a capacity of 50 tons, suitable to receive two full bulk shipments. Mounted on the silo roof is a pulse-jet type bin-vent filter, FIL-101, with polyester fabric filter elements. This filter will control dust emissions during silo filling and dense phase transport operations. The silo will be of shop welded construction, carbon steel plate, and a skirted design for support. The silo will rest on a newly poured concrete foundation.

Sorbent flow from the silo will be augmented by the use of six air slides, AS-101A through F, mounted to the interior of the silo's 60° cone bottom. The slides will use compressed air, regulated between 3 and 5 psig from a dedicated positive displacement (PD) blower situated in the silo skirt. Air from the slides fluidizes the sorbent to promote and sustain the sorbent flow from the silo. System controls permit air into the slides only when the dense phase transport system is operated. During other periods the air is vented to the atmosphere.

The area beneath the silo cone, enclosed by the skirt, will house the dense phase system transporter, ATV-101. The transporter, an ASME-designed pressure vessel, is a key component of the dense phase transport system. In addition, this area will be equipped with a steam-operated unit space heater to provide heat during maintenance activities.

Upon start, fluidized sorbent flows by gravity from the silo into the dense phase transporter vessel. In this system, dry air supplied from a slip stream of a new air-compressor is regulated down to 20 psig and used to convey the sorbent through the length of 2-inch SCH-40 carbon steel piping to the 13 separate feed hoppers. The proposed system uses a full line concept that pushes the solids in the piping much like an extruder, which results in relatively low line velocities ideal for minimizing wear and reducing the air demand.

The system operates in a batch manner, it begins with sorbent filling the transporter through a specially designed inflatable seated butterfly valve. During the fill step, displaced air and silo fluidizing

air from the PD blower carried with the solids into the transporter vessel is vented through the top of the transporter to allow easier filling. Once the vessel is filled, as determined by a level device, the inlet and the vent valves close and seal. The transporter outlet valve, FV-1505B, then opens and dry air is introduced into the transporter to displace the sorbent. Additional dry air for conveying is also injected through booster fittings, strategically spaced along the entire length of piping. When the transporter is emptied, as indicated by LSL-1502, compressed air is turned off and sorbent flow stops in the conveying pipe, the pipe remaining full of sorbent. Before the transporter is refilled, the vessel is depressurized. Control logic is vendor supplied and implemented from a custom computer code loaded in a dedicated microprocessor-based controller. The controller monitors the system I/O devices and embedded diagnostics will actuate an alarm, should a fault occur.

The transport system design permits sorbent to be directed into any one of thirteen feeders located in the facility. The number of feeders utilized in a test will be dependent on the desired injection level. Twelve feeders will be located at an elevation of 1077 feet, 6-3/8 inches on top of a new platform, which will be supported by tying into existing platform steel. The arrangement of the hoppers places six on each side of MWC Unit No. 1 in order to minimize the conveying distance from the feeders to the injectors and also to provide a symmetrical configuration to balance the pressure drop due to line losses. The sorbent feeders are volumetric devices having a metering accuracy of 1 to 2 percent. With three possible sorbents, calibration tests with each material will be conducted to characterize the screws RPM versus mass flow.

A storage hopper will rest atop each feeder and provide a stable supply of sorbent to the feeder screw. Level switches mounted on these hoppers will be integrated with the transport system to automatically initiate a refill cycle should a hopper level reach low limits. Each hopper is fitted with a vent connection that feeds a common header, which is cleaned by a filter/exhaust blower mounted at Bin 113.

Sorbent metered from the feeders falls by gravity directly into a venturi eductor and is entrained immediately in a compressed air stream used to convey the sorbent to one of the four different furnace injection levels. At furnace location Level 1, four feeders and eductors will be utilized. This arrangement was selected because of process concerns for minimizing the oxygen introduction into the oxygen-deficient zone. Flow from the feeders will be split by the use of 2-way and 4-way flow splitters, FS-102 and 101, respectively.

At Level 4, flow splitters are also utilized with a single feeder to distribute sorbent to four injection points. The nominal capacity for this screw feeder, FD-113, is 300 lb/h.

Discharge from the eductors will use a combination of hard piping and rubber transport hose. Velocity in the piping will be maintained at a relatively high level to prevent solids from dropping out

and causing pluggage. Hose length will be kept approximately the same to assure similar pressure drops and a uniform feed to each injector.

Metal Sorbent

Since the metal sorbent feed rate is relatively low at 5 lb/h, its handling utilizes a standalone bag-breaker station connected directly to a volumetric screw feeder. The sorbent is loaded manually into the station where a vent filter/exhaust blower draws a vacuum to minimize dust emissions in the building. The equipment and control scheme is similar to the acid-gas sorbent arrangement described above. One injection nozzle is provided for sorbent dispersion in the duct just downstream of the flue gas take-off for the FGR system.

Humidification

The humidification subsystem is independent from the dry sorbent injection scheme. A storage tank provides a stable suction to the centrifugal pump, PMP-101. Pump discharge pressure is 150 psig (the desired level) for atomization service. The water flow is metered and regulated by a spring and diaphragm automated control valve. In conjunction with regulating the water, air needed for fine atomization is also metered and controlled in a similar fashion.

The final location of the two humidification lances is upstream of the existing ESP. Inserted at the beginning of a 28-foot straight run of mostly 2 x 3.5 foot ductwork, the atomized spray is directed co-current with the flue gases. With the lances located on an outside section of the ductwork, air and water supply piping are electrically heat-traced and insulated to prevent freezing. The degree of humidification is monitored by four type K thermocouples placed in the humidified flue gases at the inlet to the ESP.

Compressed Air Supply

A new Sullair rotary-screw air compressor, CM-103, is to be installed on an existing concrete pad at OWEF to supply the compressed air needs of ERTS. The major air user is the humidification system. It requires approximately 300 SCF/min of compressed air for atomization. Air is also needed for dense phase transport and for injection of the sorbent. In the dense phase transport system, an air dryer, AD-100, sized to handle the demands of the transport system, will condition and dry the air servicing the system to reduce risks of material flow problems.

Equipment Layout

An isometric view of the ERTS equipment placement is illustrated in Design Drawing No. G8731E-001, Appendix F.

Major Equipment

Major equipment specified in the ERTS detail design is listed in Appendix G. Additional equipment descriptions are given under Task 4, Major Equipment Quotations, of this report.

Instrumentation

Instrumentation devices designated for the sorbent handling, humidification, and ancillary components are listed in Appendix H. A PLC is available at OWEF. Installed during the METHANE de-NOX retrofit, it will be utilized to implement control needs for ERTS. The PLC is a Square-D Model 400 networked to a Xycom keyboard panel-mounted operator interface. The capacity of the Square D is not fully utilized and with additional input/output cards, ERTS control signals can be readily handled. Actual programming of the PLC will be performed during the construction of ERTS from system control logic diagrams. Individual equipments with standalone control systems will interface with the Square-D PLC for total system control. The discrete field control and instrumentation devices will be specified in accordance with the current OWEF practices.

A separate data acquisition system, installed by IGT during the previous retrofit will be expanded to handle the added process signals to facilitate real-time process analysis during the field evaluation tests.

Electrical

The ERTS electrical power and instrumentation circuits are designated in Appendix I. Total power load will require 400-amp, 3-phase, 480-volt AC service. The new air compressor will be fed from an existing power feed, and this power feed will be provided from a breaker in OWEF's existing motor control center (MCC). A new 480-volt MCC is dedicated for ERTS. This MCC is designed with a 600-amp main breaker, a 600-amp main copper bus, a 300-amp vertical Copper bus, and a 300-amp grounding bus. It will provide power to ERTS equipment, as well as the existing FGR fan. A section of MCC will contain a 480 to 120/240-volt single-phase 45 KVA transformer with a 200-amp distribution panel equipped with a main breaker. This supply is for system lighting, control power, and 120/240-volt motor power.

Circuits are designated and identified as one of three types: (P) power, (C) 110 V control, or (E) instrumentation (low voltage).

Procurement and Construction Schedule

The anticipated ERTS procurement and construction schedule is presented in Figures 8 and 9. Data shown are obtained from vendor information and engineering estimates. The time required to complete equipment purchase and complete the site work is estimated to be 12 months.

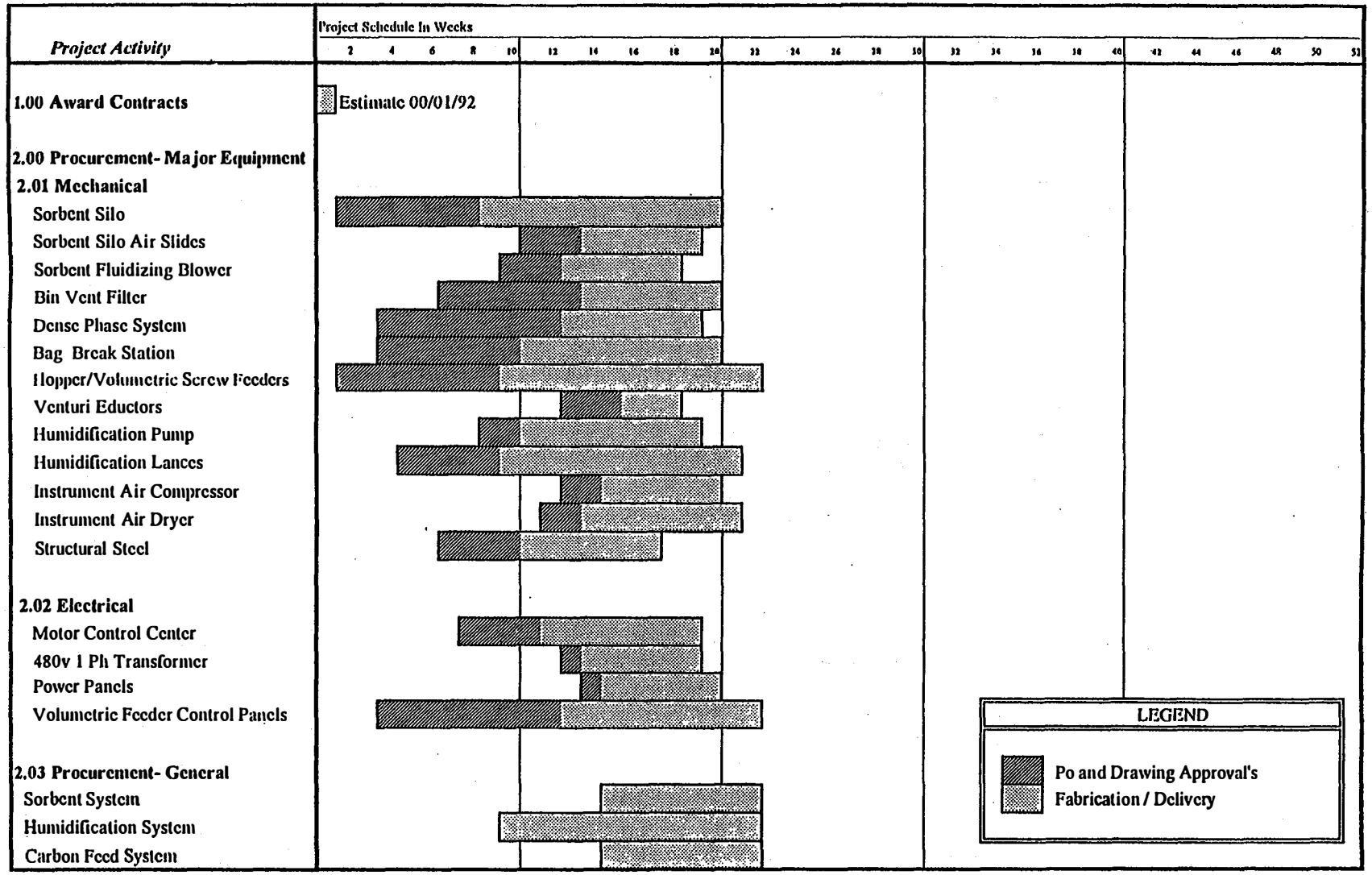

Figure 8. PROCUREMENT SCHEDULE

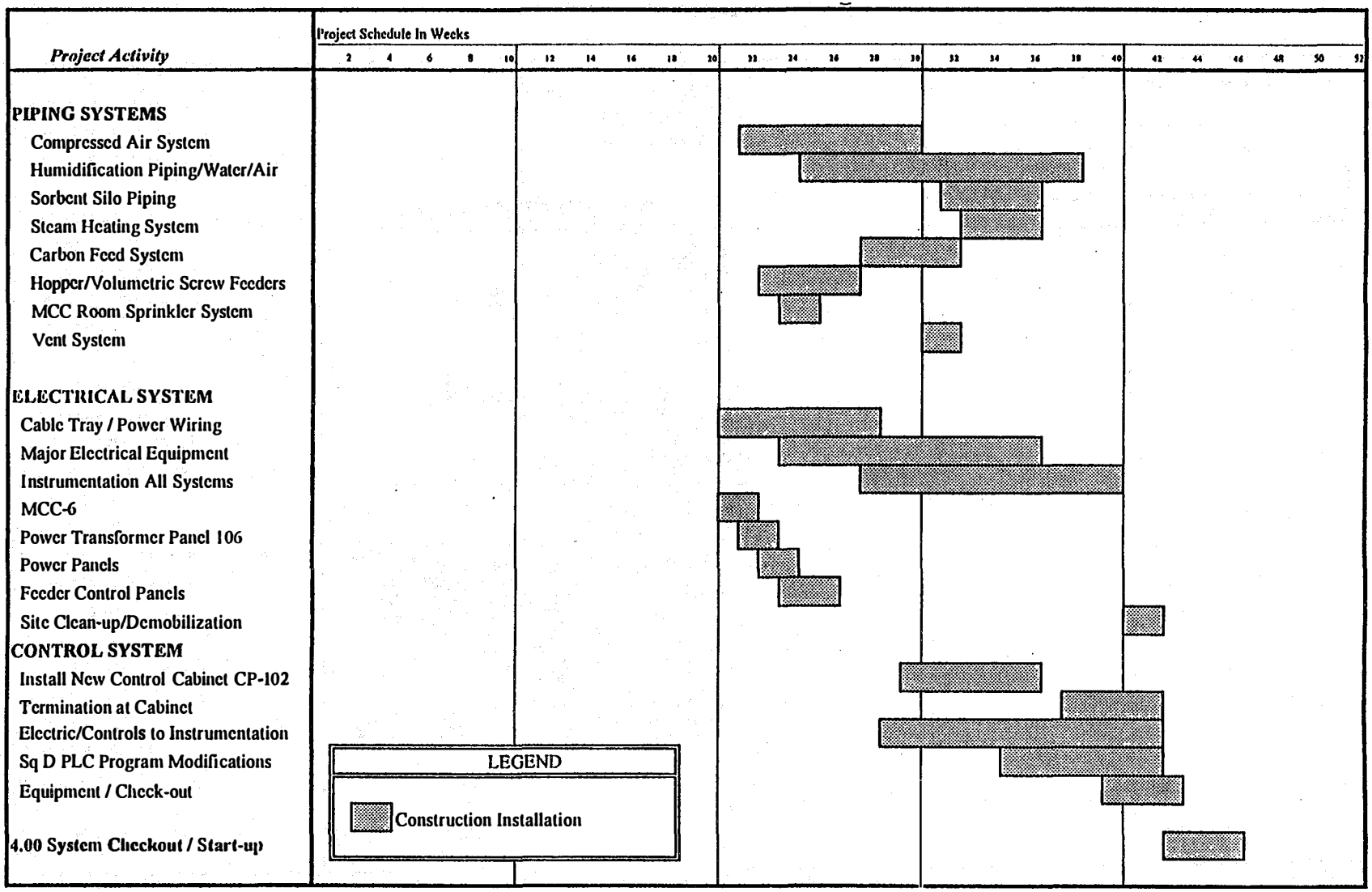

Figure 9. CONSTRUCTION SCHEDULE

Miscellaneous

OWEF Site Restoration Requirement

Site restoration responsibilities have been formally accepted by the host site owner, Olmsted County (see Appendix J for the OWEF letter of commitment). No site restoration plans were, therefore, needed.

Environmental Permit Work

Mr. Rob Dunnette, OWEF's Plant Manager, conducted all communications with the Minnesota Pollution Control Agency (MPCA). Mr. Dunnette submitted permit applications for the three new air emission sources created by the ERTS. The three are exhausts from vent filters at the silo, the feed hopper vent header, and the bag-breaker station. Approval is anticipated shortly.

TASK 3. SAFETY ANALYSIS STUDY– HAZOP REPORT

A process and operations safety review was conducted in accordance with HAZOP, an industry technique to assess the probability and risk of potential problems. The review focused on the system P&IDs, especially analyzing pieces of equipment and the effect from abnormal process conditions due to parameters such as flow, pressure, temperature, etc.

Summary

The HAZOP analysis was performed on September 3, 1992. Attendees at the session were as follows:

Energy & Environmental Research:	Bob Ashworth
	Don Engelhardt (HAZOP Team Leader)
	Don Hartsock
	Roger Huml
Institute of Gas Technology:	David Cygan
	Stanley Wohadlo
Olmsted Waste-to-Energy:	Rob Dunnette
Takuma Company Ltd.:	Kunihiro Nakazato

The approach used in performing this HAZOP study to quantify the risk associated with a given event was to combine the effects of the severity of the consequence with the likelihood of the event. A five-point scale was used with a risk ranking of "1" possessing the highest risk and a risk ranking of "5" possessing the lowest risk. The "likelihood of occurrence" is determined by using the assumption that the safeguard system has failed during the event.

Eight events were identified with a risk rank of "2". No events possessed a risk rank of "1". The remaining events, having a lower risk, are considered as insignificant. The high risk events are described as follows:

	EVENTS POSING HIGH RISK:	EVENTS POSING HIGH RISK:
1.	Vessel/Process Line:	Sorbent Silo (SIL-101)
	Parameter:	Capacity
	Deviation:	More
	Cause:	Overfilling
	Consequences:	Blow sorbent to atmosphere thru pressure relief valve (PSV-1501)
	Safeguards:	1) Level transmitter (LIT-1501) 2) Level alarm (LSH-1501)
	Severity:	2 (Moderate: injury, moderate damage)
	Likelihood:	2 (Medium: possible in plant life)
	Risk:	2
	Recommendation:	None. Safeguards deemed adequate.

2.	Vessel/Process Line:	Silo Dispatch Line and Blowpot (ATV-101)
	Parameter:	Pressure
	Deviation:	More
	Cause:	Failure of pressure reducing valve (FV-1504), fail closed
	Consequences:	Equipment damage in silo
	Safeguards:	Pressure relief valve (PSV-1504)
	Severity:	2 (Moderate: injury, moderate damage)
	Likelihood:	2 (Medium: possible in plant life)
	Risk:	2
	Recommendation:	Examine pressure rating of pot and fittings.
3.	Vessel/Process Line:	Sorbent Silo Fluidizing Blower (BL-101) and Line to Silo
	Parameter:	Pressure
	Deviation:	More
	Cause:	1) Failure of air slide blower vent valve (FV-1506) 2) Hand valve (HV-1501-C) is closed 3) Air slide is plugged (AS-101A through F)
	Consequences:	1) Overheating of blower (BL-101) 2) Air slide rupture
	Safeguards:	Pressure safety relief (PSV-1503) on blower
	Severity:	2 (Moderate: injury, moderate damage)
	Likelihood:	2 (Medium: possible in plant life)
	Risk:	2
	Recommendation:	Incorporate pressure switch high.
4.	Vessel/Process Line:	Sorbent Silo Fluidizing Blower (BL-101) and Line to Silo
	Parameter:	Flow
	Deviation:	Low
	Cause:	1) Low outlet pressure 2) Blower inlet filter plugs
	Consequences:	Overheating of blower
	Safeguards:	1) Pressure switch low (PSHL-1504) 2) Differential pressure indicator (DPI-1502)
	Severity:	2 (Moderate: injury, moderate damage)
	Likelihood:	2 (Medium: possible in plant life)
	Risk:	2
	Recommendation:	None. Safeguards deemed adequate.
5.	Vessel/Process Line:	Blowpot to Bins 101 through 113
	Parameter:	Pressure
	Deviation:	More
	Cause:	Regulator valve (FV-1504) fails open
	Consequences:	Equipment damage
	Safeguards:	None
	Severity:	2 (Moderate: injury, moderate damage)
	Likelihood:	2 (Medium: possible in plant life)
	Risk:	2

	Recommendation:	1) Evaluate the following equipment for 100 psi: Booster fittings Bin fill valves Air lines 2) Evaluate use of a relief system
6.	Vessel/Process Line:	Bins 101 through 113 (sorbent feed) to Eductors
	Parameter:	Pressure
	Deviation:	More
	Cause:	1) Bin vent filter (FIL-102) plugs 2) Plug in line 1-VA-1-2" 3) Plugged injection nozzle
	Consequences:	Feed hopper (BN-101-113) ruptures
	Safeguards:	None
	Severity:	2 (Moderate: injury, moderate damage)
	Likelihood:	2 (Medium: possible in plant life)
	Risk:	2
	Recommendation:	1) Investigate incorporation of safeguards. 2) Investigate pressure rating of bins and screw feeder.
7.	Vessel/Process Line:	Eductors and Injection Nozzles
	Parameter:	Flow
	Deviation:	No
	Cause:	Plugged nozzle
	Consequences:	Hose failure due to high temperature
	Safeguards:	None
	Severity:	2 (Moderate: injury, moderate damage)
	Likelihood:	1 (High: once in plant life)
	Risk:	2
	Recommendation:	1) Investigate length of nozzle pipe needed to dissipate the heat. 2) Investigate temperature limitations of the hose.
8.	Vessel/Process Line:	Humidification Atomizing Air (4-PA-10-1-1/2)
	Parameter:	Flow
	Deviation:	No
	Cause:	1) Shutdown of compressor 2) Fail close of control valve (FCV-1651) 3) Plugged strainer (STN-1651) 4) Frozen line
	Consequences:	1) Wets the duct 2) Equipment damage in ESP
	Safeguards:	Flow transmitter on air and water
	Severity:	2 (Moderate: injury, moderate damage)
	Likelihood:	1 (High: once in plant life)
	Risk:	2
	Recommendation:	Add heat tracing to air line.

TASK 4. MAJOR EQUIPMENT QUOTATIONS

A summary of the major ERTS equipment and their design features follow:

Sorbent Injection Equipment

Sorbent Storage Silo

Tag No.:	SIL-101
Service:	Sorbent Storage Silo
Height (ft):	27
Diameter (ft):	12
Hopper Height (ft):	12
Weight - Empty (ton):	8
Material:	A36 Carbon Steel

The sorbent storage silo has a capacity of 50 tons and is used for storing one of three possible sorbent types. All steel is to be ASTM A36 plate. The sloping hopper sections and sidewalls shall be epoxy-coated to assist flow. The silo design pressure is 6.0 oz. per square inch positive to 0.5 oz. per square inch negative. The silo is designed for mass flow with a design temperature of 120°F. A bin vent filter, a manway/pressure relief valve, guardrail, and a ladder to the roof are accessories located on top of the sloping roof.

Air Slides

Tag No.:	AS-101A/B/C/D/E/F
Service:	Sorbent Silo Air Slides
Dimensions (in.):	8W x 120L x 2D
Pressure (psig):	3

Material

Air Slide Body:	Carbon Steel
Air Slide Fabric:	Polyester

Six evenly spaced air slides are mounted on the interior of the silo's 60-degree cone bottom to fluidize the sorbent and assist flow to discharge through the hopper outlet flange. The six air slides at a pressure of 3 psig.

Fluidizing Blower

Tag No.:	BL-101
Service:	Fluidizing Blower
Type:	Positive Displacement Rotary Lobe
Discharge Pressure (psig):	3
Weight (lb):	500

Motor

HP:	15, TEFC
Voltage:	480

The fluidizing blower is used to provide compressed air to the sorbent silo air slides. This is a positive displacement rotary lobe blower. The blower is a standard skid-mounted unit with a complete set of accessories.

Bin Vent Filters

Sorbent Silo Filter

Tag No.:	FIL-101
Service:	Bin Vent Filter
Type:	Pulse Jet Cartridge
Filter Area (ft^2):	600
Filter Media:	Pleated polyester felt
Design Temp (°F):	300
Design Pressure (in. wc):	15
Design Pressure Drop (in. wc):	4-6
Weight (lb):	750
Dimensions (ft):	4W x 5.5L x 5H

The sorbent silo bin vent filter vents the transport air from truck unloading operations and fluidizing air during silo discharge operations. The filter sits over an opening located on top of the silo, SIL-101. The filter area is accessible for maintenance via a side access door. Compressed air will pulse the cloth area intermittently for cleaning purposes. Additional design features include venturi reverse-jet cleaning; quick-release cartridges; heavy-duty, all-welded carbon steel construction; air-tight gasketed access door; solid-state sequence timer; safety grid under filter media; bird screen and weatherhood on the discharge; enamel paint on the inside and outside steel surfaces; high removal efficiency, complete with all air valves and a pressure gauge for an 80 to 100-psig compressed air supply; NEMA 4 electrical control cabinet; 120 VAC power supply; and a Hi/Low differential pressure switch designed for continuous operation.

Vent Line Filter

Tag No.:	FIL-102
Service:	Vent Line Filter
Type:	Pulse Jet Cartridge
Filter Area (ft^2):	100
Filter Media:	Pleated polyester felt
Design Temp (°F):	300
Design Pressure (in. wc)	15
Design Pressure Drop (in. wc):	4-6
Weight (lb):	750
Dimensions (in.):	20W x 36L x 36H

The vent line filter vents the dense phase transport air from the feed hoppers, FD-101...113. The filter is supported directly over feed hopper BN-113. The filter area is accessible for maintenance via a side access door. Compressed air will pulse the cloth area intermittently for cleaning purposes. Additional design features include venturi reverse-jet cleaning; quick-release cartridges; heavy-duty, all-welded carbon steel construction; air-tight gasketed access door; solid-state sequence timer; safety grid under filter media; enamel paint on the inside and outside steel surfaces; high removal efficiency, complete with all air valves and a pressure gauge for an 80 to 100-psig compressed air supply; NEMA 4 electrical control cabinet; 120 VAC power supply; and a Hi/Low differential pressure switch designed for continuous operation.

Dense Phase System

General

The dense phase system will consist of a blow pot and all associated valves and controls, with a transport capacity of 3 ft^3 per cycle and sorbent transport piping designed for a full line concept. The dense phase system will transport sorbent material from the blow pot located outdoors under a bulk storage silo to 1 of 13 hoppers located within the OWEF plant near Unit No. 1.

The system will be designed to 1) convey three sorbent materials, 2) be fed by gravity from the bulk storage silo, and 3) supply the normal consumption rate of 300 lb/h (2 to 3 cycles). However, the dense phase system will be capable of continuous usage at a rate of 15 cycles per hour. Operation of the dense phase system shall be completely automatic. All control functions will be performed by a PLC supplied as an integral part of the system. The vendor's PLC will have full interface capability with the plant's existing Square-D Model 400 PLC. Compressed dry air will be supplied to the dense phase system at 100 psig.

Sorbent Testing

The equipment vendor will perform material flow testing on each of the three sorbent materials and provide a written report to document the results of all tests. The test results will be used to finalize the design parameters. IGT will have the right to witness all testing. The vendor will notify IGT 1 week prior to performing testing.

Design Features

Transporter

Main transporter vessel will be constructed according to ASME Code and supplied with a National Board Stamp and Certification. The bottom head is a 60-degree cone with aeration jets, a pressure safety valve, and all associated valves and local controls.

Tag No.:	ATV-101
Service:	Blow Pot
Operating Pressure (psig):	80
Operating Temp (°F):	100
Capacity (ft^3):	3
Design Pressure (psig):	110
Design Temp (°F):	120
Diameter (in.):	24
Height (in.):	46

The blow pot (dense phase transporter) is part of the dense phase system. The blow pot works as a single unit filling, pressurizing/trans-porting, and depressurizing. The blow pot is located directly beneath the sorbent silo, SIL-101, hopper discharge.

Transporter Valves

Transporter valves are to be Dynamic Air Posi-flate butterfly valve series 435 with Open/Close limit switches and position indicator, or an equivalent.

Programmable Logic Controller

The 120 Vac Standard independent Programmable Logic Controller System can be interfaced with Square D "SY/MAX" 400 PLC. Vendor PLC to be equipped with a liquid crystal display/keypad interface unit. The vendor PLC is to be programmed and prewired on a control cabinet panel to be mounted by others in the field. The cabinet panel shall be a half panel measuring 39-7/8-in. high by 32-in. wide, 12 gauge steel, Wiegmann catalog No. WA- 90P36F2 or equivalent. The panel shall be installed in a NEMA 12 control cabinet measuring 90-in. high, 36-in. wide, and 36-in. deep, Wiegmann catalog No. WA-903636FS single door unit or equivalent supplied by others. The liquid crystal display/keypad interface shall be shipped loose for installation by others in the cabinet door.

Booster Valves

Air assist booster fittings and accessories will be used in whatever quantity is required to properly convey the three sorbent materials.

Fill Valves

Thirteen 4-in.-diameter hopper fill valves will be Dynamic Air Posi-flate butterfly valve series 435 or an equivalent with open/close limit switches and a position indicator or equivalent.

Air Valves

Thirteen 2-in.-diameter solenoid operated air valves positioned in the transport booster air supply header will be used to control the supply of air to the booster valves for feeding the thirteen bins, BN-101 to 113.

Pipe Couplings

Compression type couplings as required will be used for sorbent transport piping. Piping is to be 2-in. Sch. 40 ASTM A106 Grade A or B. Pipe sizing will be subject to final results of sorbent material flow testing.

Sorbent Feed Bins

Bins 101 to 112

Tag No.:	BN-101BN-102 BN-103BN-104 BN-105BN-106 BN-107BN-108 BN-109BN-110 BN-111BN-112
Service:	Feed Hopper
Capacity (ft^3):	6
Design Pressure (psig):	+ 1.0 Press., - 1.0 Vac.
Dimensions (in.)	17-3/8 X 21 X 29 H
Weight (lb):	150

The sorbent feed hoppers (bins) are located at Elevation 1077 ft, 6-3/8 in., with six on each, the east and the west side of Unit No. 1. The dense phase system maintains the sorbent level in each of the 12 feed hoppers. The hoppers are connected directly to the volumetric screw feeders FD-101 to 112. Each hopper is equipped with three level probes to indicate high, low, and empty conditions. Air is vented from each hopper via a vent line to a common header.

Bin 113

Tag No.:	BN-113
Service:	Feed Hopper
Design Pressure (psig):	+ 1.0 Press., - 1.0 Vac.
Dimensions (in.)	17-3/8 x 21 x 49H
Weight (lb):	200

BN-113 sorbent feed hopper is located at Elevation 1077 ft, 6-3/8-in. at the northeast corner of Unit No. 1. The dense phase system maintains the sorbent level in the feed hopper when the Level 4 injectors are being utilized. The hopper is mounted directly to a volumetric screw feeder, FD-113. The hopper is equipped with three level probes to indicate high, low, and empty conditions. Air is vented from the hopper via a fabric filter mounted to the top of the hopper. BN-113 also receives all air vented from feed hopper bins BN-103 to 112.

Volumetric Screw Feeders

Feeders FD-101 to 112

Tag No.:	FD-101FD-102

	FD-103 FD-104 FD-105 FD-106 FD-107 FD-108 FD-109 FD-110 FD-111 FD-112
Service:	Volumetric Feeders
Type:	Screw
Screw Diameter	
Metering (in.):	1-3/8
Conditioning (in.):	10
Screw Speed (rpm):	7 - 70
Dimensions (in.):	25 x 40 x 18H
Weight (lb):	500
Material	
Screw:	304 SS
Housing:	Carbon Steel
Motor	
HP:	1, Variable Speed, TEFC
Voltage:	240

The volumetric screw feeders meter sorbent flow from the feed hoppers and discharge the sorbent to eductors for injection into the boiler. The 12 feeders are attached to the feed hoppers at Elevation 1077 ft, 6-3/8 in. Normally, feeders FD-101 to 112 will be in service for injecting sorbent through the Level 2 or the Level 3 injectors. For the Level 1 injectors, only four of the feeders will be utilized. The feed rate from the feeders in service will be manually set via a 4 to 20 madc signal to the variable speed motor drives. Each feeder is a triple auger bin discharger type with the single metering screw and twin conditioning screws geared together and driven by the single motor. The hopper design is designed to self-empty and prevent any bridging of the material. Each feeder has a feed accuracy of $\pm$2 percent.

The volumetric screw feeders will be designed to operate accurately and reliably for each of the three sorbents and its specific physical characteristics identified in the sorbents subsection.

The volumetric screw feeders will be constructed to include easy clean-out features, dust-tight with non-stainless steel parts painted, and will have a variable speed drive motor, TEFC 240 VAC.

The 13 variable speed controllers (FD-101 to 112 and FD-113) will be pre-mounted and wired by the supply vendor in two (2) NEMA 12 enclosures with a main breaker per enclosure, 6 SCR units (FD-101 to 106) per the west enclosure (Tag No. VFCP-101), and 7 SCR units (FD-107 to 113) per the east enclosure (Tag No. VFCP-102). Each panel will include a local pilot light to indicate that feeders are running per signal, HOA (Hand-off-Automatic switches), remote 4 to 20 madc I/O for speed control and feed back for each SCR, and local speed control potentiometers. A 120-volt ac single-phase blower will be furnished for pressurizing and cooling each enclosure. The blower will be mounted inside the

enclosure and will be complete with switch and separate fused circuit. The blower suction will be piped to the outside and will be provided with an easily replaceable fiberglass filter. The blower will be of sufficient size to maintain the maximum allowable temperature for the electrical components housed within the enclosure assuming 100°F ambient air conditions.

Feeder FD-113

Tag No.:	FD-113
Service:	Volumetric Feeder
Type:	Screw
Screw Diameter	
Metering (in.):	2-1/2
Conditioning (in.):	10
Screw Speed (rpm):	7 - 70
Dimensions (in.):	25 x 40 x 18H
Weight (lb):	500

Material

Screw:	304 SS
Housing:	Carbon Steel
Motor	
HP:	1, Variable Speed, TEFC
Voltage:	480

Volumetric screw feeder, FD-113, meters the sorbent flow from feed hopper BN-113 and discharges the sorbent to an eductor for injection into the Level 4 injectors at the boiler outlet. The feed rate from the feeder will be manually set via a 4 to 20 madc signal to the variable speed motor drive. The feeder is a triple auger bin discharger type with a single metering screw and twin conditioning screws geared together and driven by the single motor. The hopper is designed to self-empty and prevent any bridging of the material. The feeder has a feed accuracy of ± 2 percent.

The volumetric screw feeder will be designed to operate accurately and reliably for each of the three sorbents and its specific physical characteristics identified in the sorbents subsection.

The volumetric screw feeder will be constructed to include easy clean-out features, dust-tight with non-stainless steel parts painted, and will have a variable speed drive motor, TEFC 240 VAC.

The variable speed controller for FD-113 will be pre-mounted and wired by the supply vendor in the east panel VFCP-102.

Vent Exhaust Fan

Tag No.:	BL-102
Service:	Exhaust Fan
Suction Capacity (in. wc):	30

Weight (lb):	
Motor	
HP:	1.5, TEFC
Voltage:	480

Vent line filter, FIL-102, is equipped with a small centrifugal fan to pull air through the 150 feet of 2-inch vent line piping and the filter. This maintains a line velocity of 70 ft/s to prevent the settling of sorbent particles entrained by the air vented from the feed hoppers. Additional air is added to the system at the beginning of the vent line piping via a conservation vent damper. The fan is energized only during operation of the dense phase system.

Venturi Eductors

Eductors VE-101 to 112

Tag No.:	VE-101VE-102 VE-103VE-104 VE-105VE-106 VE-107VE-108 VE-109VE-110 VE-111VE-112
Service:	Venturi Eductor
Size	
Suction:	1-in. NPT
Motive:	1/4-in. FNPT
Discharge:	1-in. NPT
Air Usage (SCF/min):	20
Air Pressure (psig):	60 - 80
Dimensions (in.):	6.25L x 3.25H
Material:	Ht trtd carbon/alloy stl

Venturi eductors VE-101 to 112 are used to induce sorbent from the volumetric screw feeders, FD-101 to 112 into a dilute phase state with compressed air for conveying and injecting the sorbent into the boiler via Level 1, 2, and 3 injection ports. The capacity of the eductors to convey sorbent is set by regulating the air pressure to the eductors. The eductor installation details allow for quick and easy removal to permit cleaning during operation with hydrated lime.

Eductor VE-113

Tag No.:	VE-113
Service:	Venturi Eductor
Size	
Suction:	1-1/2-in. NPT
Motive:	1/2-in. FNPT
Discharge:	1-1/2-in. NPT
Air Usage (SCF/min):	50
Air Pressure (psig):	60 - 80
Dimensions (in.):	8.125L x 3.75H
Material:	Ht trtd carbon/alloy stl

Venturi eductor VE-113 is used to induce sorbent from the volumetric screw feeder FD-113 into a dilute phase state with compressed air for conveying and injecting the sorbent into the flue gases at the boiler outlet via the Level 4 injection ports. The capacity of the eductor to convey sorbent is set by regulating the air pressure to the eductor. The eductor installation details allow for quick and easy removal to permit cleaning during operation with hydrated lime.

Flow Splitters

Tag No.:	FS-101/102/103/104/105
General Service:	Flow Splitter
Specific Service:	
FS-101	Level 1, Boiler Front Center 4 Noz., 4-way splitter, 1-inch inlet, 1/2-inch outlets
FS-102	Level 1, Boiler Front Outer 2 Noz., 2-way splitter, 1-inch inlet, 3/4-inch outlets
FS-103	Level 1, Boiler Rear Center 2 Noz., 2-way splitter, 1-inch inlet, 3/4-inch outlets
FS-104	Level 1, Boiler Rear Outer 2 Noz., 2-way splitter, 1-inch inlet, 3/4-inch outlets
FS-105	Level 4, Boiler Outlet, 4-way splitter, 1-1/2-inch inlet, 3/4-inch out.
Material:	Carbon Steel
Construction:	Fabricate FS-101 and FS-105 per EER Dwg. M8731E-111 Sheet 1 Fabricate FS-102, FS-103, and FS-104 per EER Dwg M8731E-111 Sheet 2

The flow splitters are designed and employed to split a single dilute phase mixture of sorbent and transport air into equal streams hydraulically. This is done for the Level 1 boiler injection ports to the number of feeders and eductors used, thereby reducing the volume of air injected into the lower furnace (the oxygen-deficient zone). A flow splitter is also used for Level 4 injection to utilize a single feeder at this location.

Carbon Feed Equipment

Bag Breaker

Tag No.:	BBS-114
Service:	Bag Breaker Station
Hopper Discharge Flange (in.):	7.5 x 8
Filter Area (ft^2):	100
Filter Media:	Pleated polyester felt
Dimensions (in.):	36W x 50D x 82H
Weight (lb):	450
Material:	Carbon Steel
Exhauster	Tag No. BL-103
Suction Capacity (in. wc):	6

Motor	
HP:	1, TEFC
Voltage:	240

The bag breaker station controls fugitive dust emissions during the charging of the carbon sorbent feeder FD-114. Carbon supplied to the plant in 50 to 60-pound bags will be manually loaded via the bag breaker. The bag breaker station is furnished with a fabric filter and exhauster (BL-103) to pull surrounding air into the hopper during the dumping of the carbon material. The filter is cleaned via a pulse jet system. The cleaned air is discharged outside of the building through the north wall above the platform elevation 1035 ft where the bag breaker station is located near column 12D. The discharge flange of the storage hopper will be directly connected to the flange of screw feeder FD-114. A NEMA 12 cabinet is mounted directly to the unit for the filter/exhauster controls.

Volumetric Screw Feeder

Tag No.:	FD-114
Service:	Volumetric Feeder
Type:	Screw
Screw Diameter (in.)	
Metering:	3/4
Conditioning:	10
Screw Speed (rpm):	7 - 70
Dimensions (in.):	14 x 23 x 18H
Weight (lb):	135
Material:	
Screw:	304 SS
Housing:	Carbon Steel
Motor:	
HP:	1/4, Variable Spd, TENV
Voltage:	110/220

Volumetric screw feeder, FD-114, meters a carbon sorbent flow from the Bag Breaker Station hopper and discharges the sorbent to an eductor for injection into the flue gas duct just downstream of the economizer ash hopper. The feed rate from the feeder will be manually set via a 4 to 20 madc signal to the variable speed motor drive. The feeder is a triple auger bin discharger type with a single metering screw and twin conditioning screws geared together and driven by the single motor. The hopper design is designed to self-empty and prevent any bridging of material. The feeder has a feed accuracy of ± 2 percent.

Venturi Eductor

Tag No.:	VE-114
Service:	Venturi Eductor
Size	
Suction:	1-in. NPT
Motive:	1/4-in. FNPT
Discharge:	1-in. NPT

Air Usage (SCF/min):	20
Air Pressure (psig):	60 - 80
Dimensions (in.):	6.25L x 3.25H
Material:	Ht trtd carbon/alloy stl

Venturi eductor VE-114 is used to induce the carbon sorbent from the volumetric screw feeder VF-114 into a dilute phase state with compressed air for conveying and injecting the sorbent into the flue gases downstream of the economizer ash hopper outlet via a single injection point in the ductwork. The capacity of the eductor to convey sorbent is set by regulating the air pressure to the eductor. The eductor installation details allow for quick and easy removal to permit cleaning.

Humidification System Equipment

Water Tank

Tag No.:	TK-101
Service:	Water Tank
Dimensions (in.):	30 Dia. x 42L
Material:	ASTM 1020 Mld Stl
Construction:	Fabricate per ERTS Dwg. M8731E-203

The humidification water tank receives water from the existing plant non-contact cooling water discharge line near column 12D. The tank serves to provide a suction head to the humidification water pump PMP-101. The tank will be fabricated from 1/4-inch mild steel according to the requirements set forth by ERTS Drawing M8731E-203. All exterior surfaces will be shop primed.

Humidification Pump

Tag No.:	PMP-101
Service:	Humidification Water Pump
General Type:	Centrifugal, Multistage
Fluid Pumped:	Non-contact cooling water
Rated Pumping Temp (°F):	75
Suction Pressure (psig):	2.0
Discharge Pressure (psig):	150
Speed (rpm):	3500
Weight (lb):	45
Dimensions (in.):	8.5H x 8W x 40L
Material:	Carbon Steel Housing Noryl GFN2 Pltc Impeller
Motor:	
HP:	2, TEFC
Voltage:	460

The humidification pump supplies water to the humidification lances IJL- 101 and 102 located in the flue gas ductwork upstream of the ESP. The pump takes suction and is located directly below the

humidification water tank TK-101. The discharge head of 150 psig is sufficient to overcome line losses, control valve pressure drop, and still provide sufficient pressure for dual fluid atomization.

Injection Lances

Tag No.:	IJL-101/102
Service:	Humidification Inj Lance
Type:	Dual Fluid Atomization
Design Air/Water Ratio:	0.5
Water Pressure (psig):	75
Air Pressure (psig):	90
Atomizer	
Quantity:	1 per lance
Type:	EER pneumatic
Material:	304 SS
Construction:	Fabricate per EER Dwg. M8731E-204 Sheets 1 & 2

The humidification lances are used to spray water into the boiler flue gases downstream of the economizer and upstream of the ESP to enhance the performance of the ESP during sorbent injection operation. Given the constraints of the existing flue gas ductwork, it is imperative to achieve optimum atomization to minimize the mass mean droplet diameter for rapid evaporation of the injected water. The injection lances are designed to accomplish this task. The lances are to be fabricated as shown by ERTS Drawing M8731E-204, Sheet 4.

Compressed Air System Equipment

Air Compressor

Tag No.:	CM-103
Service:	Air Compressor
General type:	Rotary Screw
Discharge Pressure (psig):	100
Discharge Temp (°F):	120
Weight (lb):	5760
Dimensions (in.):	82L x 62W x 68H
Motor	
HP:	125, TEFC
Voltage:	460

The air compressor will supply compressed air for the sorbent dense phase transport system, humidification system's dual fluid atomizers, actuators, instrumentation, control valves, and for cleaning the three fabric filters. The compressor is a rotary screw type, air-cooled, with an electric motor drive sized to deliver air at 100 psig. The compressor will be manufactured by Sullair to match existing plant compressors. The compressor is to be located on an the existing foundation for the plant's reciprocating compressor, which is to be relocated by others. This location is adjacent the

south wall of the boiler building (Column line 8) between Column rows C and D on the ground floor. A sound-attenuating enclosure is included with the compressor to meet the 85 DBA at 1 meter OSHA regulation. An extra heavy-duty air filter for the air inlet is also included (to be tagged as FIL-103) as an extra option due to the plant environment. The compressor is furnished with its own motor starter, and a contact for remote start/stop has been included. The compressor is controlled via its own microprocessor controller.

Dryer Inlet Filter

Tag No.:	FIL-104
Service:	Air Dryer Inlet Filter
Type:	Oil/Grease/Water Cartridge Filter
Operating Temp (°F):	110
Pressure Drop (psig):	2 clean
Weight (lb):	6.5
Dimensions (in.):	4-3/4D x 17L
Inlet/Outlet Connections:	1-1/4-in. FPT

To protect the instrument air dryer AD-100, the dryer is equipped with inlet and outlet cartridge filters. The air dryer inlet filter is a coalescing-type filter that will remove particles down to 1 micron and liquids down to 0.4 ppm, which carry over from the air compressor CM-103. The filter media is borosilicate microfiber of graded density. The housing is constructed of lightweight cast aluminum, corrosion-treated on the inside surface, and epoxy-painted on the outside.

Dryer Outlet Filter

Tag No.:	FIL-105
Service:	Air Dryer Outlet Filter
Type:	Particle/Oil Crtdge Fltr
Operating Temp (°F):	110
Pressure Drop (psig):	2 clean
Weight (lb):	6.5
Dimensions (in.):	4-3/4D x 17L
Inlet/Outlet Connections:	1-1/4-in. FPT

To provide a final cleaning of the air to the instrument air distribution system, the dryer discharge is equipped with a cartridge filter. The air dryer outlet filter is a coalescing type filter that will remove particles down to 1 micron and lubricant aerosols down to 0.09 ppm. The filter media is borosilicate microfiber of graded density. The housing is constructed of lightweight cast aluminum, corrosion-treated on the inside surface, and epoxy-painted on the outside.

Air Dryer

Tag No.:	AD-100
Service:	Instrument Air Dryer
Type:	Heatless Regenerative
Discharge Dew Point (°F):	-40
Operating Temp (°F):	110
Weight (lb):	235
Dimensions (in.):	36W x 25D x 60H
Inlet/Outlet Connections:	1-1/4-in. FPT
Power Required:	115V, single phase, 60 cycle

The instrument air dryer dries a portion of the compressed air produced by the air compressor CM-103. The air dryer is used to provide dry air for outside use at the sorbent silo, the dense phase sorbent transport system, cleaning the three fabric filters, and miscellaneous instrumentation and actuators. The dryer is a heatless regenerative type designed to dry the air to a dew point of -40°F. With the dual tower design operation is continuous. There is an approximate loss of 15% flow capacity during the purge cycle stage of the regeneration cycle. The desiccant is activated alumina. Each tower is equipped with its own local pressure indicator. Added controls included are a cycle failure alarm and light, high dew point indicator with light, tower sequence lights, and a dry contact for a "system fault" alarm to the control room.

Separator

Tag No.:	SEP-101
Service:	Oil/Water Separator
Fluid Treated:	Compressor/Dryer Prefilter Condensate
Effluent Quality:	Less than 15 ppm oil
Gravity Separator	
Dimensions (in.):	29D x 36H
Weight (lb):	85
Connections:	1-1/2-in. Condensate inlet 3/4-in. Oil outlet 1-in. Water outlet
Carbon Filter	
Capacity (gal):	16
Dimensions (in.):	16D x 24H
Weight (lb):	66
Connections:	1-in. Water inlet/outlet

The oil/water separator treats the combined condensate from the air compressor, CM-103, and the air dryer inlet filter, FIL-104. The treated condensate is discharged to sewer while the oil is temporarily stored in a separate container to be manually disposed of with other contaminated oil.

Air Receiver

Tag No.:	AR-101
Service:	Transport Air Receiver
Diameter (in.):	24
Height (in.):	48
Design Temp (°F):	450
Design working pressure (psig):	200
Weight (lb):	227

The transport air receiver receives air from the instrument air dryer AD-100. The receiver serves to provide surge capacity, thereby reducing pressure pulsations from the operation of the dense phase transport system blowpot ATV- 101. The receiver is fabricated in accordance per the ASME Boiler and Pressure Vessel code, stamped, and national board registered.

Miscellaneous Equipment

Silo Heater

Tag No.:	HTR-101
Service:	Silo Skirt Space Heater
Type:	Fin and Tube Extended Surface
Duty (Btu/h):	200,000
Steam Usage (lb/h):	250 @ 50 psig Sat.
Dimensions (in.):	28W x 28D x 23H
Weight (lb):	180
Blower	
Capacity (CF/min):	2750
Motor:	1/4 HP, TEFC, 110 V

The silo skirt space heater provides heat to the enclosed silo cone area. The heater uses 50 psig saturated steam from the plant's 50 psig header to heat air via a heating element consisting of fin and tube extended surface of aluminum fins bonded to copper tubing. Air is passed over the heater element via a blower mounted directly to the heater. The blower is controlled by a locally mounted thermostat.

Recommended Vendors

The ERTS equipment specifications were distributed to several competitive vendors, and vendor responses were received. Appendix K shows the costs and the recommended vendors.

TASK 5. CONSTRUCTION RFQ PACKAGE

An extensive and comprehensive construction specification was assembled. Appendix L contains the construction RFQ package manual's Table of Contents. In it is a description of the material procurement and construction work required to retrofit ERTS to the OWEF Unit No. 1 located in Rochester, Minnesota, at 301 Silver Creek Road.

A general review of the work scope is presented in lieu of a lengthy document. Work under the RFQ includes furnishing all equipment and materials; providing all labor, supervision, management; and all construction equipment, consumables, materials, and services to complete the ERTS construction. The variety of work tasks is listed but not limited to the following items:

- Perform razing and alterations to the existing Boiler Building platforms and structural steel at Elevations 1035 ft and 1077 ft.
- Furnish, fabricate, and erect structural steel, floor grating, stair stringers, stair treads, and handrails.
- Furnish reinforcing steel, concrete placement, finishing, curing, and other appurtenant work for concrete silo foundation, and equipment bases.
- Furnish and install sorbent transport, water, and compressed air piping as shown on drawings.
- Furnish and install piping insulation for the following two systems: 1) Steam and Condensate Piping and 2) Outdoor Water and Compressed Air Humidification System Piping.
- Furnish and install the following mechanical equipment and material below as detailed in the RFQ.
    - Sorbent Injection Equipment
    - Carbon Feed Equipment
    - Humidification System Equipment
    - Compressed Air System Equipment
    - Miscellaneous Equipment
    - Instrumentation and Valves
- Furnish and erect the sorbent storage silo, including accessories indicated on drawings.
- Furnish all labor and material for surface preparation and painting, as specified.
- Design, furnish, assemble, and install control cabinet, CP-102 and modifications to existing Square-D PLC control system.
- Furnish and install the following electrical equipment:
    - ERTS Motor Control Center
    - 480 V Breaker in Existing MCC
    - AC Panelboards
    - Dry Type Transformer
    - Raceway and Conductors

- Lighting and Receptacles
- Grounding
- Freeze Protection

- Furnish and install lighting and convenience receptacles.
- Furnish, install, and terminate wiring for power, instrumentation, and control.
- Provide man-hours, cost, and schedule information.
- Participate in biweekly review meetings to report schedule and overall project performance.

BIDDER LIST

After discussions with OWEF, six prospective general contractors were identified for distribution of the RFQ specification manual. The contractors are as follows:

1. Harris Mechanical Contr., Co.
   2300 Territorial Rd.
   St. Paul, MN 55114
   Attn: Mr. Ron Peterson
   (612) 646-2911
   FAX (612) 646-6800

2. Moorehead Machinery and
   Boiler Company
   4377 University Ave. NE
   Minneapolis, MN 55418
   Attn: Mr. Jim Knop
   (612) 789-3541
   FAX (612) 789-3540

3. Energy and Environmental
   Research Corporation
   P.O. Box 153
   Orrville, OH 44667
   Attn: Mr. Don Hartsock
   (216) 682-4007
   FAX (216) 684-2110

4. Conveyors Incorporated
   2735 South Hwy 55
   Eagan, NM 55121
   Attn: Mr. Jody Bystrom
   (800) 328-3737
   (612) 456-9225
   FAX (612) 456-0268

5. HiMec Inc.
   1400 N.W. 7th Street
   P.O. Box 4700
   Rochester, MN 55903-4700
   Attn: Mr. Charles Hiley Sr.
   (507) 281-4000
   FAX (507) 281-5206

6. Hunt Electric Corp.
   2717 W. Hwy. 14
   Suite E
   Rochester, MN 55901
   Attn: Mr. John Cruz
   (507) 281 1185
   FAX (507) 281-2307

COST AND SCHEDULE SUMMARY

A summary of project costs for the ERTS construction at OWEF is presented on the following page. A third-party cost estimation software system named Questimate, developed by the ICARUS Corporation, was utilized. The Questimate data base was reconfigured to accept major equipment prices received during Task 4 in its determination of system costs. See Appendix M for an example of the Questimate report summary. Based on the Questimate data and additional analytical and manpower costs, a summary of anticipated costs for the ERTS installation is shown in Table 3 (see Appendix N for additional backup).

Major component procurement action is estimated to require about 5-1/2 months to complete. An additional 6-1/2 months are estimated to be required in the field for millwrights, electricians, and pipefitters, to complete the retrofit and for shakedown. Final planning will be structured to minimize the outage period for Unit No. 1. Figures 8 and 9 illustrate the estimated durations for the procurement action and the major construction tasks.

Table 3. ERTS EQUIPMENT PROCUREMENT, CONSTRUCTION, AND TESTING COST SUMMARY

	IGT	Subcontractor	
Phase II. Procurement and Construction			
Procurement	$444,800	$856,800	
Construction	$401,400	$1,136,500	
Subtotal	$846,200	$1,993,300	
Total			$2,839,500
Phase III. Testing			
Operation/CEM	$1,293,300		
Metal/Dioxin		$1,269,600	
Subtotal	$1,293,300	$1,269,600	
Total			$2,562,900
Restoration[a]	--	--	--
Total			$5,402,400

[a] Restoration costs to be cofunded by OWEF.

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4. Fields, G. R., McDonald, B. L. and McDannel, M. D., "Selective Noncatalytic Reduction (SNCR) Performance on Three California Waste-to-Energy Facilities." Paper presented at the Second International Conference on Municipal Waste Combustion, Tampa, FL, April 16-19, 1991.

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APPENDIX A. Test Matrix

MSW SORBENT INJECTION

B = Baseline ; MDOX = METHANE de-NOX ; MDTOX = METHANE de-TOX ; BE = Best estimate ; S = Select

Sampling Locations:M1=Lower Furnace;M3=Upper Furnace;M5=ESP Inlet;M6=Stack

OPERATING CONDITIONS

			ACID GAS SORBENT TYPE AND INJECTION LOCATION																ACID GAS SORBENT MIXING						ACID GAS SORBENT AMOUNT		ACID GAS SORBENT DISTRIBUTION			ACID GAS SORBENT OPTIMUM CONDITIONS					
TEST CONDITIONS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
NUMBER OF SAMPLE PERIODS	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	3	3	3
CONFIGURATION	B	MDNOX	B									MDTOX											B				MDTOX						B		
MSW,% CAPACITY	100	100	100									100											100				100					80	100		80
NATURAL GAS																																			
FLOW,% HEAT INPUT	0	15	No									15											0				15						0		
INJECTION LOCATION	No	BE	No									BE											No				BE						No		
NOMINAL VELOCITY	No	BE	No									BE											No				BE						No		
FLUE GAS RECIRCULATION																																			
FLOW RATE	No	BE	No									BE											No				BE						No		
INJECTION LOCATION	No	BE	No									BE											No				BE						No		
NOMINAL VELOCITY	No	BE	No									BE									BE/2	BEX2	B				BE						B		
OVERFIRE AIR																																			
FLOW RATE	B	BE	B									BE											B				BE						B		
INJECTION LOCATION	B	I3	B									I3											B				I3						B		
NOMINAL VELOCITY	B	BE	B									BE											BE/2	BRX2	S		BE						S		
UNDERGRATE AIR DISTRIBUTION	B	BE	B									BE								BE/2	BEX2	BE	B				BE						B		
ACID GAS SORBENT																																			
TYPE	No		$Ca(OH)_2$			$CaCO_3$[a]			$NaHCO_3$[a]			$Ca(OH)_2$			$CaCO_3$[a]			$NaHCO_3$[a]					S												
FLOW RATE	No		BE									BE													BE/2	BEX2	S								
INJECTION LOCATION	No		I1	I3	I4	I1	I3	I4	I1	I3	I4	I1	I3	I1	I3	I1	I3	I4	I3	I3	I1	I1	I3	I3	S1	S1	I/A	I/B	I/A&I/B	S2	S1	S	S2	S1	S
METALS SORBENT																																			
TYPE	No																																		
FLOW RATE	No																																		
INJECTION LOCATION	No																																		
H20																																			
FLOW RATE	No																																		
NOMINAL VELOCITY	No																																		
INJECTION LOCATION	No																																		
MEASUREMENTS																																			
IGT ● DETAILED OPERATING DATA[b]	✓																																		
IGT ● O2,CO,CO2,NO_x,HCL,SO2 BY CEMs AND TEMPERATURE BY SUCTION (8 POINT TRAVERSE)	M1,M3		M3																										M1,M3					
IGT ● O2,CO,CO2,NO_x,HCL,SO2 BY CEMs AND TEMPERATURE BY THERMOCOUPLE (POINT OR INTEGRATED)	M5/M6																																		
○ ORGANICS (EPA M23)	M5,M6		No																										M5,M6					
○ PM/METALS (EPA MULTIMETALS TRAIN)	M5,M6		No																										M5,M6					
○ Hg (101A)	M5,M6		No																										M5,M6					
IGT ● FLY ASH SAMPLE	M5																																		

[a]OPTIONAL [b]MSW,NATURAL GAS,FLUE GAS RECIRCULATION,UNDERGRATE AIR,OVERFIRE AIR,STEAM FLOWS,TEMPERATURES,PRESSURES,FURNACE TEMPERATURES,ETC.

MSW SORBENT INJECTION

B = Baseline ; MDOX = METHANE de-NOX ; MDTOX = METHANE de-TOX ; BE = Best estimate ; S = Select

Sampling Locations : M1=Lower Furnace ; M3=Upper Furnace ; M5=ESP Inlet ; M6=Stack

OPERATING CONDITIONS

	ACID GAS SORBENT + HUMIDIFICATION LEVEL & MIXING						ACID GAS SORBENT + METALS SORBENT TYPE INJECTION LOCATION & AMOUNT						AG+ M SORBENT + HUMIDIFICATION INJECTION LOCATION & AMOUNT					OPTIMUM CONDITIONS					PERFORMANCE TEST
TEST CONDITIONS	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61
NUMBER OF SAMPLE PERIODS	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	3	3	1	3	1	3	1	1
CONFIGURATION	B																	MDTOX				B				S
MSW,% CAPACITY	100																	100				100	80	100	80	S
NATURAL GAS																										
FLOW,% HEAT INPUT	0																	15				0				S
INJECTION LOCATION	No																	BE								S
NOMINAL VELOCITY	No																	BE								S
FLUE GAS RECIRCULATION																										
FLOW RATE	No																	BE				No				S
INJECTION LOCATION	No																	BE				No				S
NOMINAL VELOCITY	No																	BE				No				S
OVERFIRE AIR																										
FLOW RATE	B					B												BE				B				S
INJECTION LOCATION	B					B												BE				B				S
NOMINAL VELOCITY	S					S												BE				S				S
UNDERGRATE AIR DISTRIBUTION	B					B												BE				B				S
ACID GAS SORBENT																										
TYPE	S																No	S	No	S				No		S
FLOW RATE	S																No	S	No	S				No		S
INJECTION LOCATION	S																No	S	No	S				No		S
METALS SORBENT																										
TYPE	No						A		B		S									S				No		S
FLOW RATE	No						BE				BE/2	BEX2	S							S				No		S
INJECTION LOCATION	No						S1	S2	S1	S2	S									S				No		S
H20																										
FLOW RATE	BE			BE/2	BEX2	S	No						BE	BE/2	BEX2	S				S				No		S
NOMINAL VELOCITY	BE		BE/2	BEX2	S		No						S							S				No		S
INJECTION LOCATION	I5						No						I5											No		S

MEASUREMENTS

IGT ●	DETAILED OPERATING DATA[b]	√																								
IGT ●	O2,CO,CO2,NO_x,HCL,SO2 BY CEMs AND TEMPERATURE BY SUCTION (8 POINT TRAVERSE)	No																M1,M3								No
IGT ●	O2,CO,CO2,NO_x,HCL,SO2 BY CEMs AND TEMPERATURE BY THERMOCOUPLE (POINT OR INTEGRATED)	M5/M6																								
○	ORGANICS (EPA M23)	No																M5,M6								No
○	PM/METALS (EPA MULTIMETALS TRAIN)	No						M5,M6																		No
○	Hg (101A)	No																M5,M6								No
IGT ●	FLY ASH SAMPLE	M5						No										M5								No

[a]OPTIONAL [b]MSW,NATURAL GAS,FLUE GAS RECIRCULATION,UNDERGRATE AIR,OVERFIRE AIR,STEAM FLOWS,TEMPERATURES,PRESSURES,FURNACE TEMPERATURES,ETC.

APPENDIX B. ERTS Mass Balance

FLOW RATE lb/HR.

STREAM		1	2	3	4	5	6	7	8	9	10	11	12
DESCRIPTION	MW	MSW TO FURNACE	UNDERFIRE AIR *	FLUE GAS RECYCLE	NATURAL GAS	BOTTOM ASH DISCHARGE	OVERFIRE AIR	SORBENT INJECTION	SUPER HEATED STEAM	BOILER FEED WATER	HUMIDI-IFICATION WATER	ECONOMIZER OUTLET	METALS SORBENT SILO
CO_2	44.009			997.97								7815.12	
CH_4	16.043				254.28								
O_2	31.998		6759.90	376.58			2897.10					2949.43	
N_2	28.014		22264.13	4141.78			9541.85					32444.38	
HCL	36.461												
SO_2	64.062												
H_2O	18.015	1105.89		528.30					26700.00	26700.00	2950	4136.42	
C	12.011	1907.20											5.00
H	1.008	275.23											
O	15.999	1391.08									NOTE:		
N	28.014	8.3									FLOW IS		
S	32.064	11.63									@ 70°		
CL	35.453	8.86									APPROACH		
ASH		1666.80		5.96		1514.02					FOR 120°	152.80	
$CaCO_3$	100.088							294.00			APPROACH		
$MgCO_3$	84.313										FLOW IS		
INERT				0.21		0.50		6.00			2360 PPH	5.50	
CaO	56.079			4.91		11.45						125.90	
MgO	40.304												
$CaSO_4$	136.136			1.78		4.12						45.30	
$CaCl_2$	110.306			0.50		1.10						12.70	
TOTAL STREAM LBS/HR		6374.99	29024.03	6057.99	254.28	1531.19	12438.95	300.00	26700.00	26700.00	2360	47687.55	5.00
SCFM			6322		100		2709						
TEMPERATURE(F°)		70	70	475	70	1200	70	70	640	200	60	475	70
PRESSURE (PSIA)		14.7	15.0	15.0	15.0	14.7	15.0	14.7	615.0	620.0	90	14.6	14.7

* Stream 2 includes furnace air infiltration.

FLOW RATE lb/HR.

STREAM		13	14	15	16	17	18	19	20	21	22
DESCRIPTION	MW	ESP AIR INFILTRATION	FLY ASH DISCHARGE	ESP OUTLET	ESP INLET	SORBENT TRANSPORT AIR	SORBENT INJECTION AIR (LEVELS 2/3)	HUMID-IFICATION ATOMIZING AIR	POST-BOILER SORBENT INJECTION AIR (LEVEL 4)	SORBENT SILO FLUIDIZING AIR	METALS SORBENT INJECTION AIR
CO_2	44.009			7815.12	7815.12						
CH_4	16.043										
O_2	31.998	3370.99		6586.42	3315.43	93		350	•55•	350	21
N_2	28.014	11101.95		44724.33	33622.38	297		1125	•175•	1120	71
HCL	36.461										
SO_2	64.062								NORMAL FLOW		
H_2O	18.015			7085.42	7086.42				0 SCFM		
C	12.011		5.00		5.00						
H	1.008										
O	15.999										
N	28.014										
S	32.064										
Cl	35.453										
ASH			152.80		152.80						
$CaCO_3$	100.088										
$MgCO_3$	84.313										
INERT			5.50		5.50						
CaO	56.079		125.90		125.90						
MgO	40.304										
$CaSO_4$	136.136		45.30		45.30						
$CaCl_2$	110.306		12.70		12.70						
TOTAL STREAM LBS/HR		14472.94	347.20	66312.29	52186.55	390		1475	230	1470	92
SCFM						85		321	50	320	20
TEMPERATURE(F°)		70	275	275	275	110		110	110	120	110
PRESSURE (PSIA)		14.7	14.7	14.6		55-70		115	75-95	18-20	75-95

APPENDIX C. ERTS Process Flow Diagram

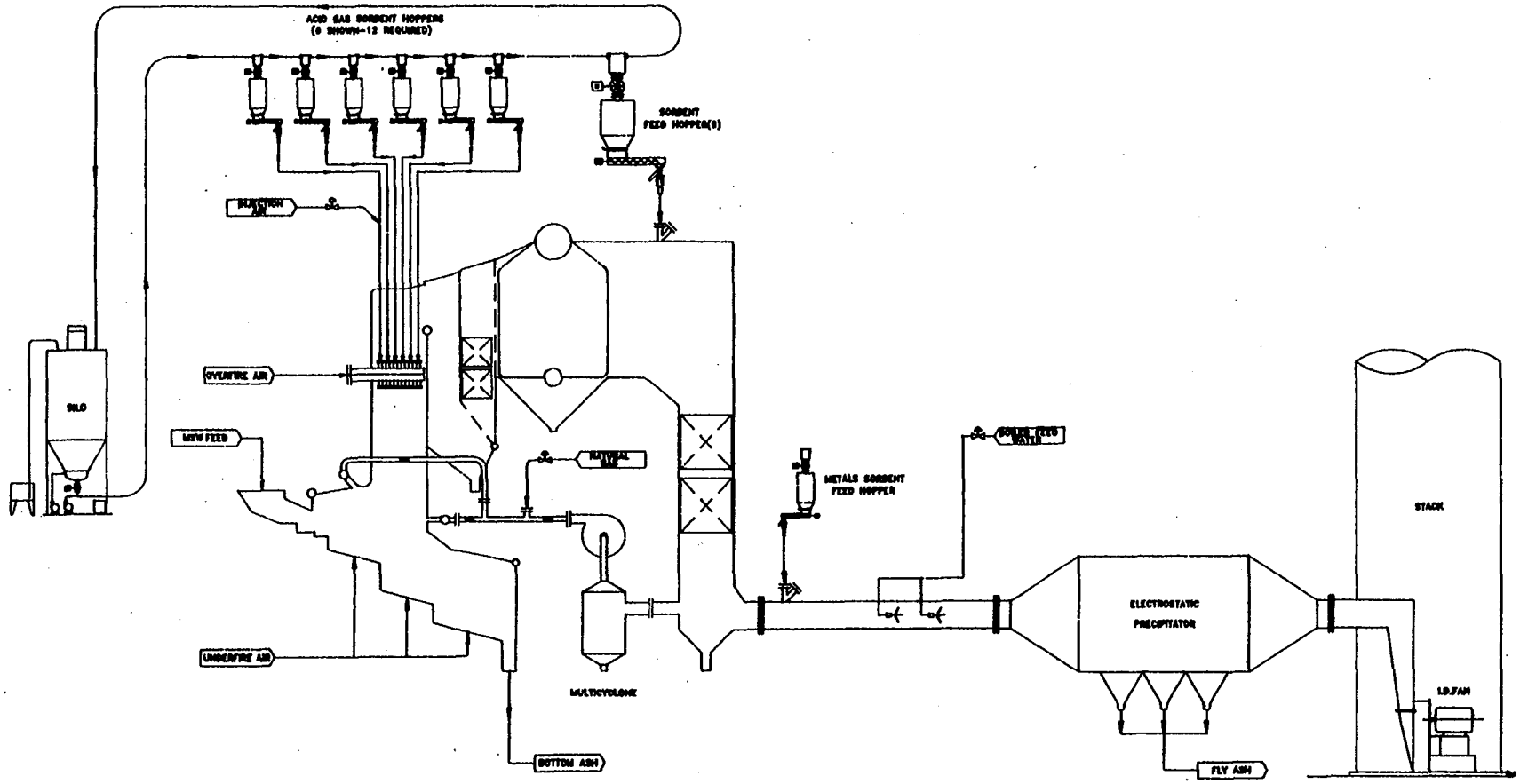


Figure C-1. ERTS PROCESS FLOW DIAGRAM

APPENDIX D. ERTS Design Drawing Index

APPENDIX D. ERTS Design Drawing Index

DRAWING TITLE	DRWG NO.	REV. NO	DATE
GENERAL:			
1. Drawing Index	G8731E-000	0	
2. System Isometric	G8731E-001	0	
3. Plot Plan	G8731E-002	0	
PROCESS:			
4. Process Flow Diagram	P8731E-001	0	
5. Piping & Instrument Diagram, Sht. 1 of 4	P8731E-002	0	
6. Piping & Instrument Diagram, Sht. 2 of 4	P8731E-0020	0	
7. Piping & Instrument Diagram, Sht. 3 of 4	P8731E-002	0	
8. Piping & Instrument Diagram, Sht. 4 of 4	P8731E-002	0	
9. Control Schematic of S.I. & Humid.	P8731E-003	0	
10. Utility Flow Diagram	P8731E-004	0	
11. Humidification Control Logic	P8731E-007	0	
12. Sorbent System Control Logic, Sht. 1 of 5	P8731E-008	0	
13. Sorbent System Control Logic, Sht. 2 of 5	P8731E-008	0	
14. Sorbent System Control Logic, Sht. 3 of 5	P8731E-008	0	
15. Sorbent System Control Logic, Sht. 4 of 5	P8731E-008	0	
16. Sorbent System Control Logic, Sht. 5 of 5	P8731E-008	0	
17. Process & Instrumentation Symbols	STD-001	0	

STRUCTURAL:

18. Sorbent Equip. - EL 1077' Structural Plans	S8731E-100	0
19. Foundation Plans, Sec. and Details	S8731E-101	0
20. Bag Buster Ser. 319 Str. Sup.- EL 1035, Sht. 1 of 2	S8731E-102	0
21. Bin #13 Access Plate. Arrgmt. & Details, Sht. 2 of 2	S8731E-102	0
22. Sorbent Sys. Str. Stl. Supports	S8731E-103	0
23. Humidification Access Platform - Details	S8731E-300	0
24. Ladder & Handrail Details	STD-151	0

MECHANICAL:

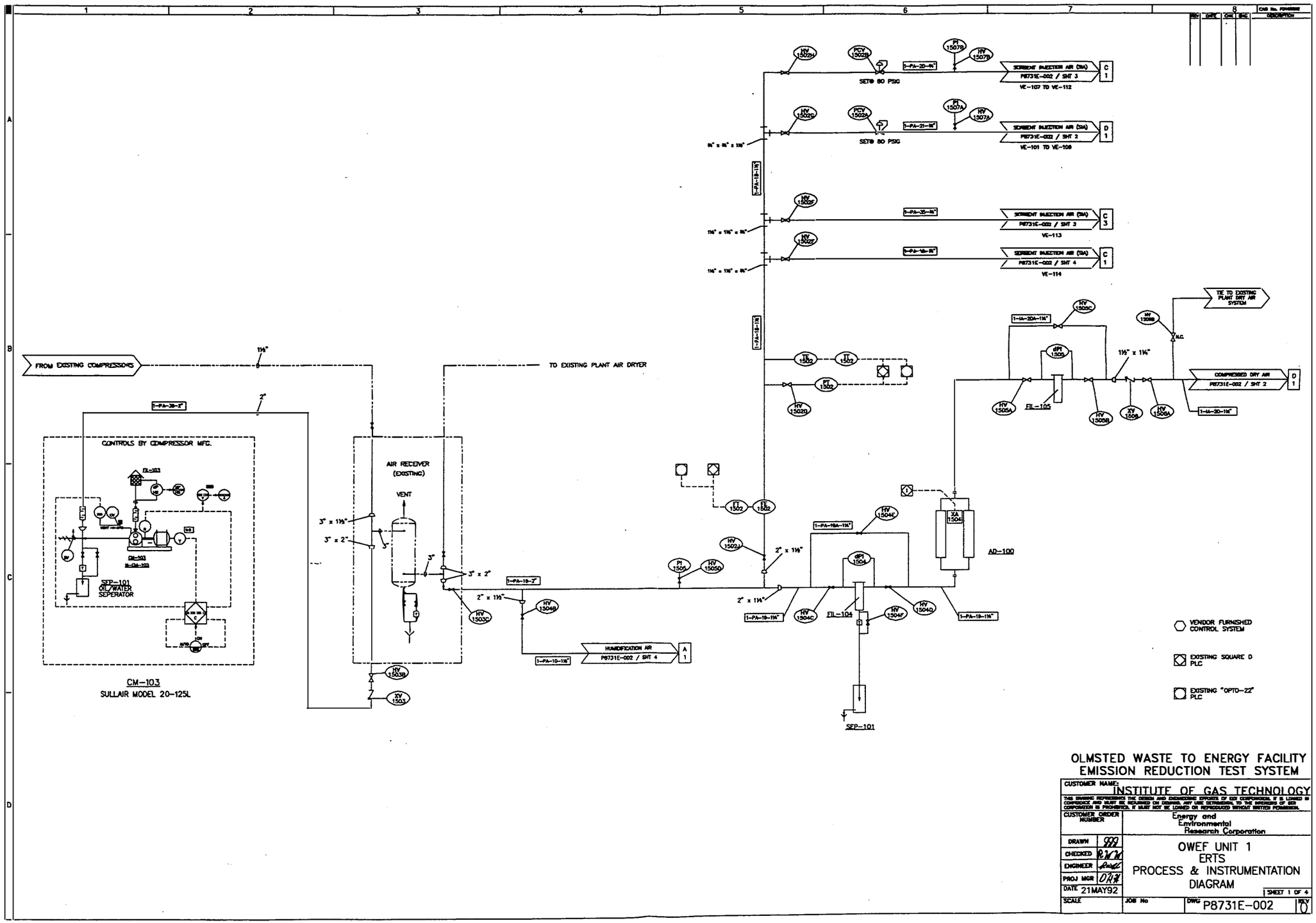
25. Sorbent Equip. Arrgmt. w/OFA, Sht. 1 of 3	M8731E-101	0
26. Sorbent Equip. Arrgmt. @ Economizer, Sht. 2 of 3	M8731E-101	0
27. Sorbent Equip. Arrgmt. w/OFA - Details,Sht. 3 of 3	M8731E-101	0
28. Sorbent Equip. Arrgmt. w/FGR	M8731E-102	0
29. Sorbent Silo & Equip. Arrangement, Sht. 1 of 4	M8731E-103	0
30. Sorbent Silo & Equip. Arrangement, Sht. 2 of 4	M8731E-103	0
31. Sorbent Silo & Equip. Arrangement, Sht. 3 of 4	M8731E-103	0
32. Sorbent Silo & Equip. Arrangement, Sht. 4 of 4	M8731E-103	0
33. OFA Insert Mod. & Sorbent Noz. Detail	M8731E-104	0
34. FGR Insert Mod. & Sorbent Noz. Det. @ F.W., Sht. 1 of 2	M8731E-105	0
35. FGR Insert Mod. & Sorbent Noz. Det. @ R.W., Sht. 2 of 2	M8731E-105	0

36. Sorbent Injection Noz. @ Economizer	M8731E-106	0
37. Sorbent Flow Splitter Details, Sht. 1 of 2	M8731E-111	0
38. Sorbent Flow Splitter Details, Sht. 2 of 2	M8731E-111	0
39. Sorbent Sys. Piping & Supports, Sht. 1 of 5	M8731E-112	0
40. Sorbent Sys. Piping & Supports, Sht. 2 of 5	M8731E-112	0
41. Sorbent Sys. Piping & Supports, Sht. 3 of 5	M8731E-112	0
42. Sorbent Sys. Piping & Supports, Sht. 4 of 5	M8731E-112	0
43. Sorbent Sys. Piping & Supports, Sht. 5 of 5	M8731E-112	0
44. Overfire Air Sorbent Noz. & Hose Arrgmt., Sht. 1 of 2	M8731E-113	0
45. Overfire Air Sorbent Noz. & Hose Arrgmt., Sht. 2 of 2	M8731E-113	0
46. Sorbent Sys. Bin #113 Transition Details	M8731E-115	0
47. Humidification Sys. Equip. Arrgmt.	M8731E-200	0
48. Humidification Sys. Piping & Sup. - Water, Sht. 1 of 2	M8731E-201	0
49. Humidification Sys. Water Piping @ Lances, Sht. 2 of 2	M8731E-201	0
50. Humidification Sys. Piping & Sup. - Air	M8731E-202	0
51. Humidification Sys. Head Tank Details	M8731E-203	0
52. Humidification Sys. Lance Instln. Det., Sht. 1 of 2	M8731E-204	0
53. Humidification Sys. Lance Instln. Det., Sht. 2 of 2	M8731E-204	0

54.	Compressed Air Sys. Equip. Arrgmt.	M8731E-300	0
55.	Compressed Air Sys. Piping Arrgmt, Sht. 1 of 3	M8731E-301	0
56.	Compressed Air Sys. Piping @ Compr., Sht. 2 of 3	M8731E-301	0
57.	Compressed Air Sys. Piping @ Feeders, Sht. 3 of 3	M8731E-301	0
58.	Carbon Feed Sys. Arrgmt., Sht. 1 of 2	M8731E-400	0
59.	Carbon Feed Sys. Arrgmt., Sht. 2 of 2	M8731E-400	0
60.	Carbon Feed Sys. Transition Piece Det.	M8731E-401	0
61.	Utility Piping Arrgmt. & Details	M8731E-500	0
62.	Steam Piping - Silo Heater	M8731E-501	0
ELECTRICAL:			
63.	Electrical One Line, Sht. 1 of 3	E8731E-001	0
64.	Electrical One Line, Sht. 2 of 3	E8731E-001	0
65.	Electrical One Line, Sht. 3 of 3	E8731E-001	0
66.	Conduit/Raceway - Cable Routing Sht. 1 of 5	E8731E-002	0
67.	Conduit/Raceway - Cable Routing Sht. 2 of 5	E8731E-002	0
68.	Conduit/Raceway - Cable Routing Sht. 3 of 5	E8731E-002	0
69.	Conduit/Raceway - Cable Routing Sht. 4 of 5	E8731E-002	0
70.	Conduit/Raceway - Cable Routing Sht. 5 of 5	E8731E-002	0
71.	Formal Circuit List	E8731E-003	0
72.	Raceway List	E8731E-004	0
73.	Equipment Grounding	E8731E-005	0

74.	Misc. Ltg. & Recp.	E8731E-006	0
75.	Motor Starter Wiring & Schematics	E8731E-007	0

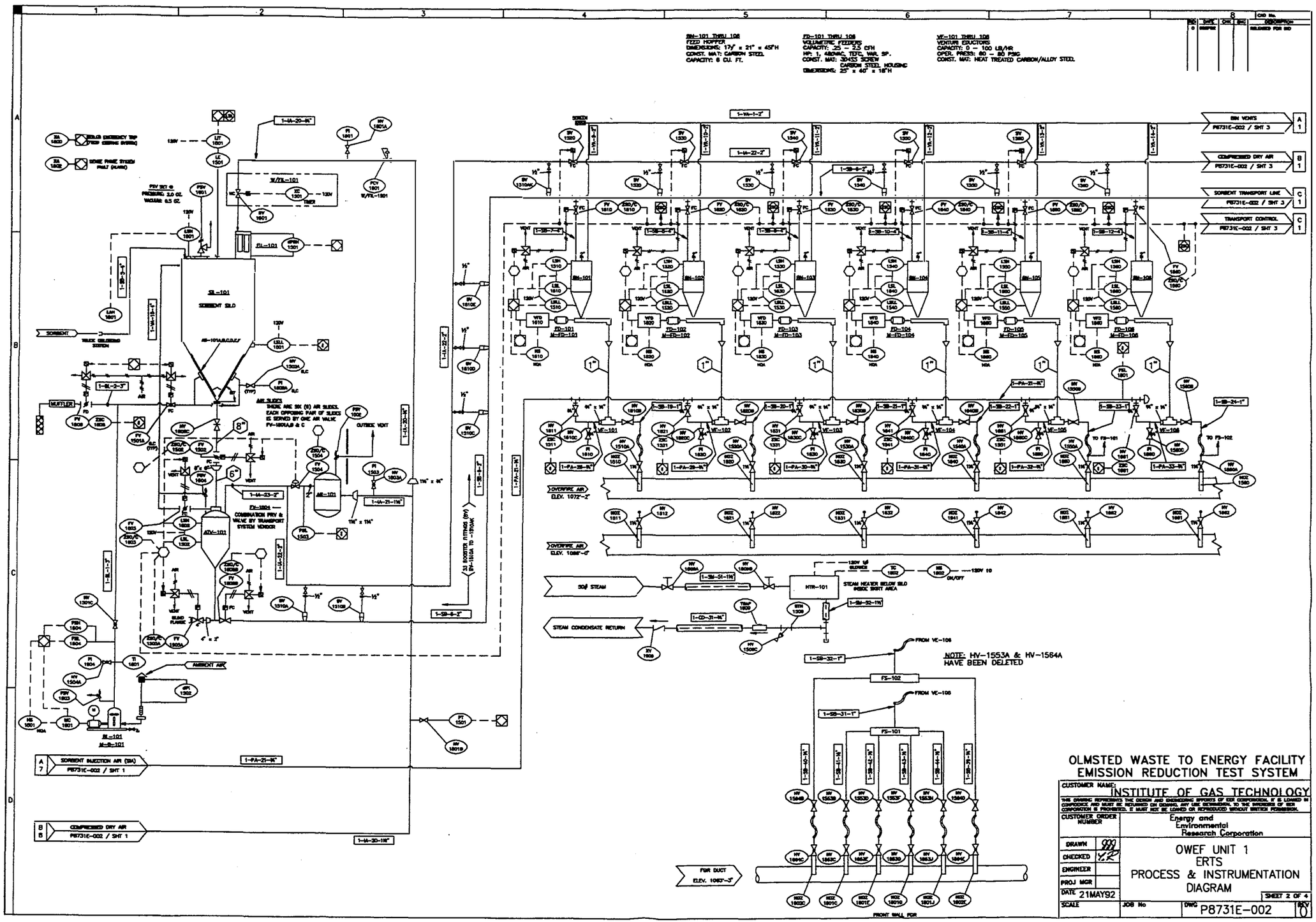
APPENDIX E. ERTS Piping and Instrumentation Diagram

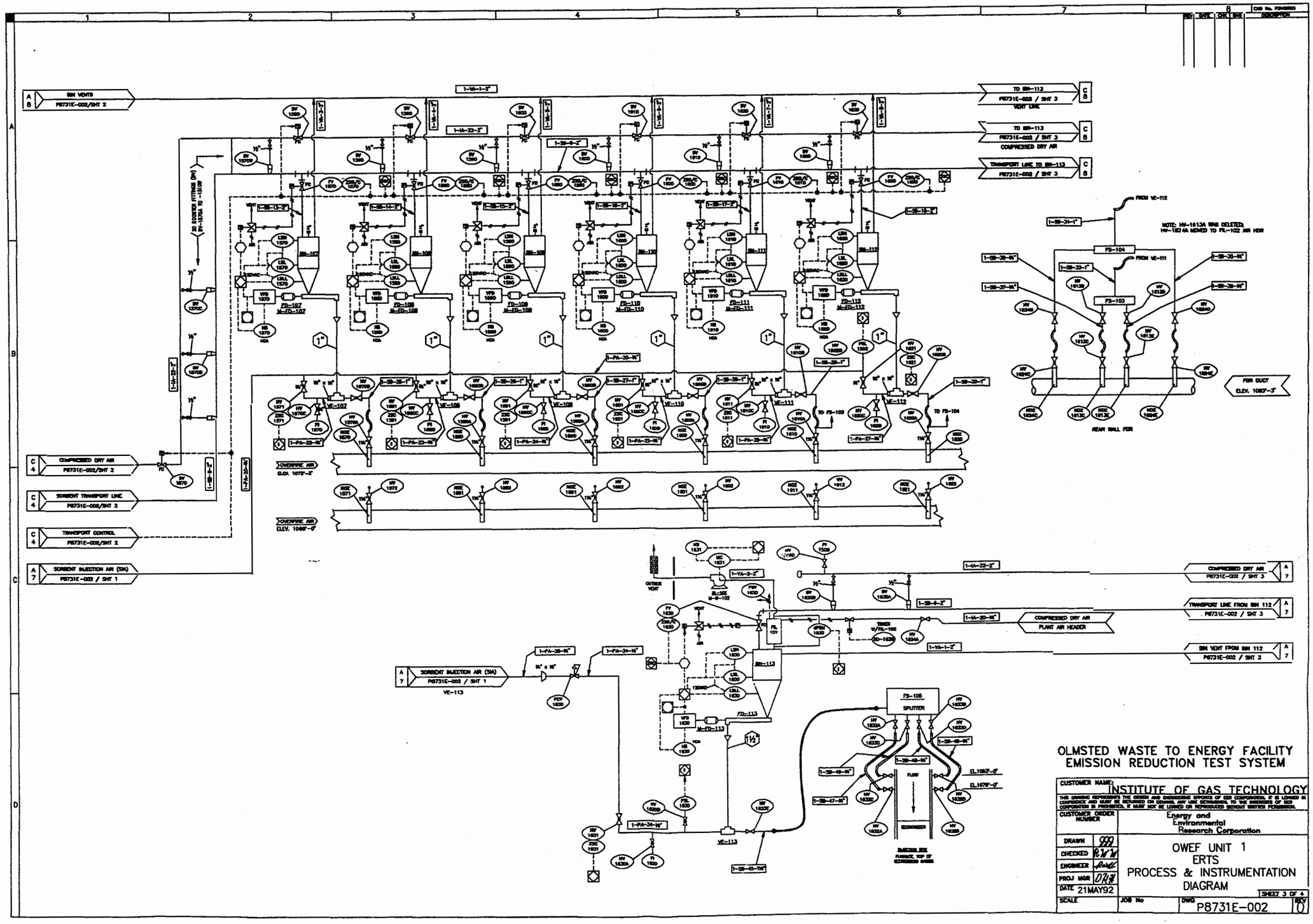


OLMSTED WASTE TO ENERGY FACILITY
EMISSION REDUCTION TEST SYSTEM

CUSTOMER NAME:	INSTITUTE OF GAS TECHNOLOGY
CUSTOMER ORDER NUMBER	Energy and Environmental Research Corporation
DRAWN	
CHECKED	
ENGINEER	
PROJ MGR	
DATE	21MAY92
SCALE	
JOB No	
DWG	P8731E-002
REV	0

OWEF UNIT 1
ERTS
PROCESS & INSTRUMENTATION
DIAGRAM
SHEET 1 OF 4

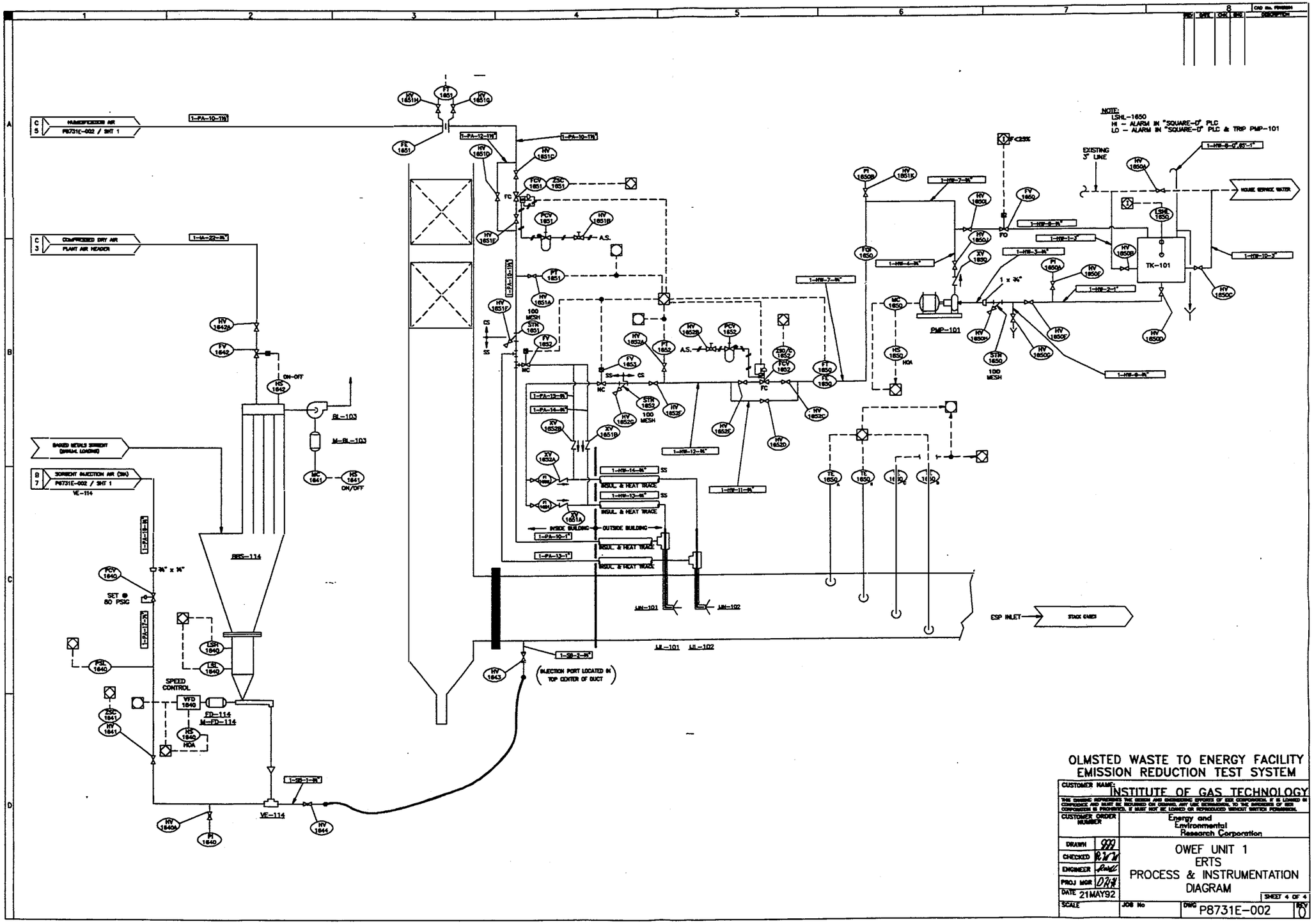

BIN VENTS
P8731E-002 / SHT 3
COMPRESSED DRY AIR
P8731E-002 / SHT 3
SORBENT TRANSPORT LINE
P8731E-002 / SHT 3
TRANSPORT CONTROL
P8731E-002 / SHT 3
SORBENT INJECTION AIR (SIA)
P8731E-002 / SHT 1
COMPRESSED DRY AIR
P8731E-002 / SHT 1
30# STEAM
STEAM CONDENSATE RETURN
OVERFIRE AIR
ELEV. 1072'-2"
OVERFIRE AIR
ELEV. 1088'-0"
FGR DUCT
ELEV. 1063'-3"
NOTE: HV-1553A & HV-1564A HAVE BEEN DELETED
OLMSTED WASTE TO ENERGY FACILITY
EMISSION REDUCTION TEST SYSTEM
CUSTOMER NAME: INSTITUTE OF GAS TECHNOLOGY
CUSTOMER ORDER NUMBER
Energy and Environmental Research Corporation
DRAWN
CHECKED
ENGINEER
PROJ MGR
DATE 21MAY92
SCALE
OWEF UNIT 1
ERTS
PROCESS & INSTRUMENTATION DIAGRAM
SHEET 2 OF 4
JOB No
DWG P8731E-002
REV 0



OLMSTED WASTE TO ENERGY FACILITY
EMISSION REDUCTION TEST SYSTEM

CUSTOMER NAME:	INSTITUTE OF GAS TECHNOLOGY
CUSTOMER ORDER NUMBER	Energy and Environmental Research Corporation
DRAWN	
CHECKED	
ENGINEER	
PROJ MGR	
DATE 21MAY92	OWEF UNIT 1 ERTS PROCESS & INSTRUMENTATION DIAGRAM
SCALE	JOB No / DWG P8731E-002 / REV 0

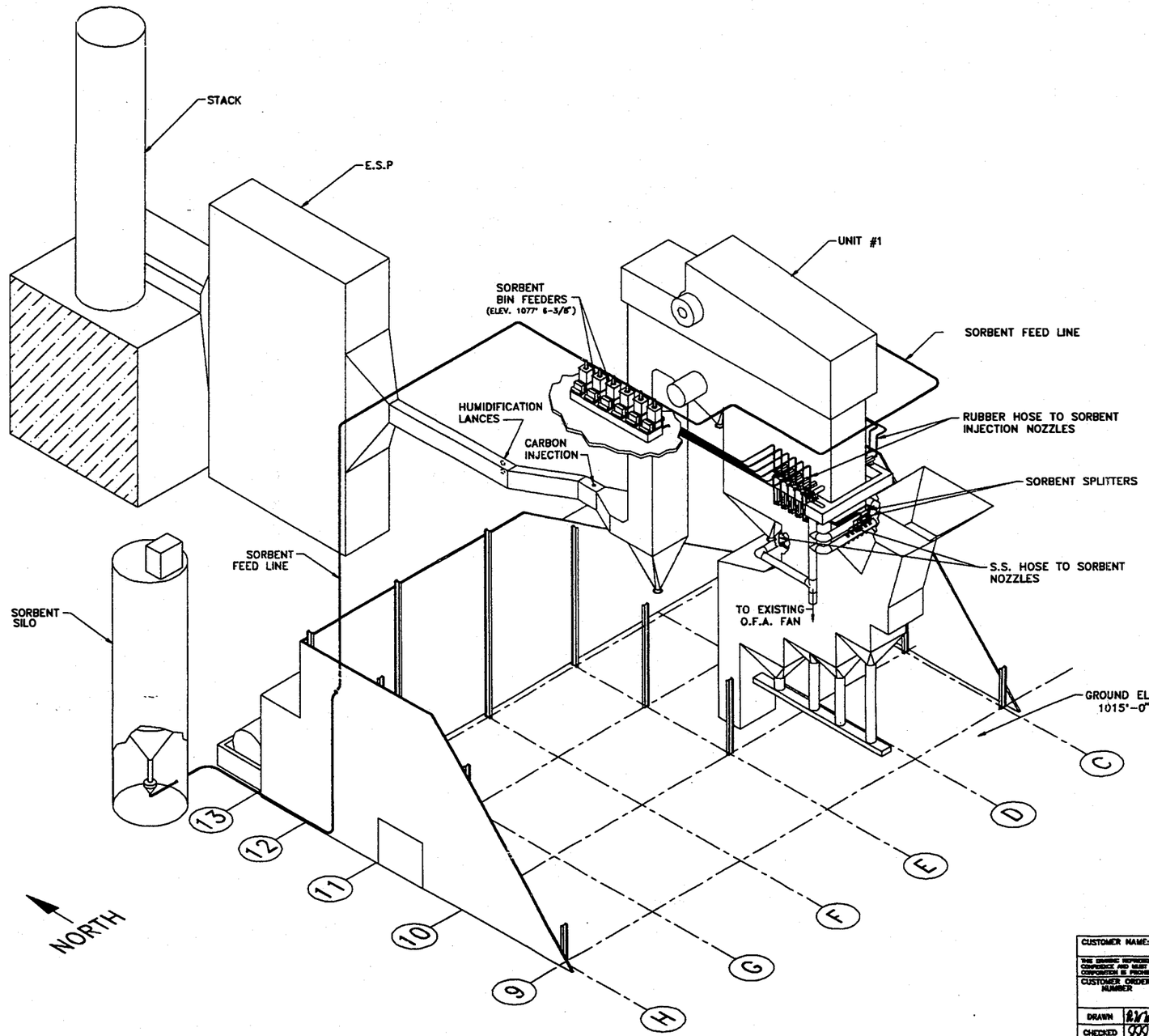
SHEET 3 OF 4



OLMSTED WASTE TO ENERGY FACILITY
EMISSION REDUCTION TEST SYSTEM

CUSTOMER NAME:	INSTITUTE OF GAS TECHNOLOGY
CUSTOMER ORDER NUMBER	Energy and Environmental Research Corporation
DRAWN	9999
CHECKED	
ENGINEER	
PROJ MGR	
DATE	21MAY92
SCALE	
	OWEF UNIT 1 ERTS PROCESS & INSTRUMENTATION DIAGRAM
	SHEET 4 OF 4
JOB No	
DWG	P8731E-002
REV	0

APPENDIX F. Isometric Design Drawing



CUSTOMER NAME:	INSTITUTE OF GAS TECHNOLOGY
CUSTOMER ORDER NUMBER	Energy and Environmental Research Corporation
DRAWN	EVV
CHECKED	
ENGINEER	
PROJ MGR	
DATE	2 OCT 92
SCALE	1/8=12
JOB No	8731
DWG	G8731E-001
REV	0

OLMSTED
WASTE-TO-ENERGY FACILITY
EMISSIONS REDUCTION TESTING
GENERAL SYSTEM ISOMETRIC

APPENDIX G. Major Equipment List

MAJOR EQUIPMENT LIST IGT UNIT #1 REVISION DATE 9-29-72

BY HCD

TAG #	SERVICE	P&ID NUMBER	POWER SOURCE	PURCHASE ORDER #
AD-100	INSTRUMENT AIR DRYER	P8731E-002/2	120 VOLT	
AR-101	TRANSPORT AIR RECEIVER	P8731E-002/2		
AS-101A	SORBENT SILO AIR SLIDE A	P8731E-002/2		
AS-101B	SORBENT SILO AIR SLIDE B	P8731E-002/2		
AS-101C	SORBENT SILO AIR SLIDE C	P8731E-002/2		
AS-101D	SORBENT SILO AIR SLIDE D	P8731E-002/2		
AS-101E	SORBENT SILO AIR SLIDE E	P8731E-002/2		
AS-101F	SORBENT SILO AIR SLIDE F	P8731E-002/2		
ATV-101	SORBENT TRANSPORTER	P8731E-002/2		
BL-101 M-B-101	SORBENT FLUIDIZING BLOWER	P8731E-002/2		
BL-102 M-B-102	EXHAUST FAN (FIL-102) FOR DUST COLLECTION SYSTEM	P8731E-002/3	480 VOLT	(W/FIL-102)
BL-103 M-B-103	EXHAUST FAN FOR BBS-114	P8731E-002/4	480 VOLT	W/BBS-101
BN-101 M-FD-101	HOPPER / VOLUMETRIC SCREW FEEDER #101 (BOILER INLET)	P8731E-002/2	120 VOLT	
BN-102 M-FD-102	HOPPER / VOLUMETRIC SCREW FEEDER #102 (BOILER INLET)	P8731E-002/2	120 VOLT	
BN-103 M-FD-103	HOPPER / VOLUMETRIC SCREW FEEDER #103 (BOILER INLET)	P8731E-002/2	120 VOLT	
BN-104 M-FD-104	HOPPER / VOLUMETRIC SCREW FEEDER #104 (BOILER INLET)	P8731E-002/2	120 VOLT	
BN-105 M-FD-105	HOPPER / VOLUMETRIC SCREW FEEDER #105 (BOILER INLET)	P8731E-002/2	120 VOLT	
BN-106 M-FD-106	HOPPER / VOLUMETRIC SCREW FEEDER #106 BOILER INLET)	P8731E-002/2	120 VOLT	

MAJOR EQUIPMENT LIST IGT UNIT #1 REVISION DATE 9-29-72

BY HCD

TAG #	SERVICE	P&ID NUMBER	POWER SOURCE	PURCHASE ORDER #
BN-107 M-FD-107	HOPPER / VOLUMETRIC SCREW FEEDER #107 (BOILER INLET)	P8731E-002/3	120 VOLT	
BN-108 M-FD-108	HOPPER / VOLUMETRIC SCREW FEEDER #108 (BOILER INLET)	P8731E-002/3	120 VOLT	
BN-109 M-FD-109	HOPPER / VOLUMETRIC SCREW FEEDER #109 (BOILER INLET)	P8731E-002/3	120 VOLT	
BN-110 M-FD-110	HOPPER / VOLUMETRIC SCREW FEEDER #110 (BOILER INLET)	P8731E-002/3	120 VOLT	
BN-111 M-FD-111	HOPPER / VOLUMETRIC SCREW FEEDER #111 (BOILER INLET)	P8731E-002/3	120 VOLT	
BN-112 M-FD-112	HOPPER / VOLUMETRIC SCREW FEEDER #112 (BOILER INLET)	P8731E-002/3	120 VOLT	
BN-113 M-FD-113	HOPPER / VOLUMETRIC SCREW FEEDER #113 (BOILER OUTLET)	P8731E-002/3	120 VOLT	
BN-114 M-FD-114	HOPPER / VOLUMETRIC SCREW FEEDER #114 (DUCT FEEDER)	P8731E-002/4	120 VOLT	
BBS-114	BAG BREAK STATION BBS-114	P8731E-002/4		
CM-103	INSTRUMENT AIR COMPRESSOR	P8731E-002/1	480 VOLT	
FIL-101	BIN VENT FILTER	P8731E-002/2		
FIL-102	VENT LINE FILTER FOR HOPPERS BN101 THRU BN113	P8731E-002/3		
FIL-103	INSTRUMENT AIR COMPRESSOR CM-103 FILTER	P8731E-002\1		
FIL-104	COELESCING FILTER	P8731E-002/1		
FIL-105	AIR FILTER	P8731E-002/1		
FS-101	FLOW SPLITTER #1	P8731E-002/2		
FS-102	FLOW SPLITTER #2	P8731E-002/2		
FS-103	FLOW SPLITTER #3	P8731E-002/3		

MAJOR EQUIPMENT LIST IGT UNIT #1 REVISION DATE 9-29-72

BY HCD

TAG #	SERVICE	P&ID NUMBER	POWER SOURCE	PURCHASE ORDER #
FS-104	FLOW SPLITTER #4	P8731E-002/3		
FS-105	FLOW SPLITTER #5	P8731E-002/3		
HTR-101	SILO SKIRT STEAM HEATER	P8731E-002/2	120 VOLT	
IJL-101	HUMIDFICATION INJECTION LANCES	P8731E-002/4		
IJL-102	HUMIDFICATION INJECTION LANCES	P8731E-002/4		
IJN-101A,B,C	HUMIDIFICATION LANCE NOZZLES	P8731E-002/4		
IJN-102A,B,C	HUMIDIFICATION LANCE NOZZLES	P8731E-002/4		
PMP-101	HUMIDFICATION PUMP	P8731E-002/4	480 VOLT	
SEP-101	OIL WATER SEPARATOR	P8731E-002/1		
SIL-I01	SORBENT SILO	P8731E-002/2		
TK-101	HUMIDIFICATION WATER TANK	P8731E-002/4		
VE-101	VENTURI EDUCTORS #101	P8731E-002/2		
VE-102	VENTURI EDUCTORS #102	P8731E-002/2		
VE-103	VENTURI EDUCTORS #103	P8731E-002/2		
VE-104	VENTURI EDUCTORS #104	P8731E-002/2		
VE-105	VENTURI EDUCTORS #105	P8731E-002/2		
VE-106	VENTURI EDUCTORS #106	P8731E-002/2		
VE-107	VENTURI EDUCTORS #107	P8731E-002/3		

MAJOR EQUIPMENT LIST IGT UNIT #1 REVISION DATE 9-29-72

BY HCD

TAG #	SERVICE	P&ID NUMBER	POWER SOURCE	PURCHASE ORDER #
VE-108	VENTURI EDUCTORS #108	P8731E-002/3		
VE-109	VENTURI EDUCTORS #109	P8731E-002/3		
VE-110	VENTURI EDUCTORS #110	P8731E-002/3		
VE-111	VENTURI EDUCTORS #111	P8731E-002/3		
VE-112	VENTURI EDUCTORS #112	P8731E-002/3		
VE-113	VENTURI EDUCTORS #113	P8731E-002/3		
VE-114	VENTURI EDUCTORS #114 CARBON SORBENT	P8731E-002/4		
LVDP-106	120/240 VOLT 200 AMP 1 PHASE POWER PANEL	SEE ELEC. DRAWING		
TLVD-106	480 VOLT PRIMARY 120/240 SECONDARY 1 PHASE TRANSFORMER	SEE ELEC. DRAWING		
LVDP-107	120/240 VOLT 60 AMP 12 CKT 1PHASE POWER PANEL	SEE ELEC. DRAWING		
LVDP-108	120/240 VOLT 80 AMP 20 CKT 1PHASE POWER PANEL	SEE ELEC. DRAWING		
MCC-6	IGT MOTOR CONTROL CENTER #6	SEE ELEC. DRAWING	480 VOLT	
VFCP-101	VOLUMETRIC FEEDER CONTROL FEEDER PANEL #1	SEE ELEC. DRAWING	120 VOLT	
VFCP-102	VOLUMETRIC FEEDER CONTROL FEEDER PANEL #2	SEE ELEC. DRAWING	120 VOLT	
VFCP-103	VOLUMETRIC FEEDER CONTROL FEEDER PANEL #3	SEE ELEC. DRAWING	120 VOLT	
CP-102	MAIN CONTROL PANEL FOR DPS & SQ-D PLC	SEE ELEC. DRAWING	120 VOLT	

APPENDIX H. Instrument List

INSTRUMENT COMPONENT LIST IGT UNIT 1

BY HCD REVISION DATE 9-24-92

TAG NUMBER	I/O TYPE	SERVICE	P&ID NUMBER	PURCHASE ORDER #	MANUFACTURER SUPPLIER	MODEL NUMBER	RANGE
LIT-1501	AI	SORBENT SILO LEVEL TRANSMITTER	P8731E-002/2				
LE-1501		SORBENT SILO LEVEL ELEMENT	P8731E-002/2				
LSH-1501	DI	SORBENT SILO LEVEL SWITCH (HIGH)	P8731E-002/2				
LSLL-1501	DI	SORBENT SILO LEVEL SWITCH (LOW-LOW)	P8731E-002/2				
LAH-1501		SORBENT SILO LOCAL LEVEL TRUCK STATION ALARM (HORN & LIGHT)	P8731E-002/2				
dPSH-1501	DI	SORBENT SILO VENT FILTER DIFFERENTIAL PRESSURE SWITCH	P8731E-002/2			SUPPLIED BY FIL-101 MANUFACTURER	
SV-1501		SORBENT SILO VENT FILTER BAG CLEANING SOLENOID VALVE	P8731E-002/2			SUPPLIED BY FIL-101 MANUFACTURER	
PCV-1501		SORBENT SILO VENT FILTER CLEANING AIR PRESSURE REGULATOR	P8731E-002/2			SUPPLIED BY FIL-101 MANUFACTURER	
FV-1501A	DO	SORBENT SILO AIR SLIDE AIR VALVE (A)	P8731E-002/2				
FV-1501B	DO	SORBENT SILO AIR SLIDE AIR VALVE (B)	P8731E-002/2				
FV-1501C	DO	SORBENT SILO AIR SLIDE AIR VALVE (C)	P8731E-002/2				
HV-1501A		PI-1501 ISOLATION VALVE (MANUAL)	P8731E-002/2				
HV-1501B		PT-1501 ISOLATION VALVE (MANUAL)	P8731E-002/2				
HV-1501C		SORBENT FLUIDIZING BLOWER (BL-101) OUTLET SHUT-OFF VALVE (MANUAL)	P8731E-002/2				
PI-1501		SORBENT SILO FILTER (FIL-101) BAG CLEANING AIR PRESSURE INDICATOR	P8731E-002/2				
PSV-1501		SORBENT SILO PRESSURE RELIEF VALVE	P8731E-002/2			SUPPLIED BY SILO MANUFACTURER	

INSTRUMENT COMPONENT LIST IGT UNIT 1

BY HCD REVISION DATE 9-24-92

TAG NUMBER	I/O TYPE	SERVICE	P&ID NUMBER	PURCHASE ORDER #	MANUFACTURER SUPPLIER	MODEL NUMBER	RANGE
TI-1501		SORBENT FLUIDIZING AIR BLOWER (BL-101)TEMPERATURE INDICATOR	P8731E-002/2				
PT-1501	AI	SORBENT TRANSPORT AIR PRESSURE TRANSMITTER	P8731E-002/2				
HS-1501	DO DI	SORBENT FLUDIZING AIR BLOWER (BL-101) HAND SWITCH (HOA)	P8731E-002/2				
PSL-1501	DI	SORBENT INJECTION AIR (LOW) PRESSURE SWITCH (VE-101/-106)	P8731E-002/2				
NOZ-1501C		SORBENT INJECTION NOZZLE FRONT WALL FGR DUCT	P8731E-002/2				
NOZ-1501E		SORBENT INJECTION NOZZLE FRONT WALL FGR DUCT	P8731E-002/2				
NOZ-1501G		SORBENT INJECTION NOZZLE FRONT WALL FGR DUCT	P8731E-002/2				
NOZ-1501J		SORBENT INJECTION NOZZLE FRONT WALL FGR DUCT	P8731E-002/2				
XC-1501		FIL-101 BAG CLEANER PULSE TIMER CONTROL	P8731E-002/2			SUPPLIED BY FIL-101 MANUFACTURER	
PI- 1502A		SORBENT SILO AIR SLIDES LOCAL AIR PRESSURE INDICATOR	P8731E-002/2				
PI- 1502B		SORBENT SILO AIR SLIDES LOCAL AIR PRESSURE INDICATOR	P8731E-002/2				
PI- 1502C		SORBENT SILO AIR SLIDES LOCAL AIR PRESSURE INDICATOR	P8731E-002/2				
HV-1502A		PI-1502A ISOLATION VALVE (MANUAL)	P8731E-002/2				
HV-1502B		PI-1502B ISOLATION VALVE (MANUAL)	P8731E-002/2				
HV-1502C		PI-1502C ISOLATION VALVE (MANUAL)	P8731E-002/2				
HV-1502D		PT-1502 ISOLATION VALVE (MANUAL)	P8731E-002/2				

INSTRUMENT COMPONENT LIST IGT UNIT 1

BY HCD REVISION DATE 9-24-92

TAG NUMBER	I/O TYPE	SERVICE	P&ID NUMBER	PURCHASE ORDER #	MANUFACTURER SUPPLIER	MODEL NUMBER	RANGE
HV-1502E		VE-114 INJECTION AIR HEADER SHUT-OFF VALVE (MANUAL)	P8731E-002/1				
HV-1502F		VE-113 INJECTION AIR HEADER SHUT-OFF VALVE (MANUAL)	P8731E-002/1				
HV-1502G		VE-101 TO VE-106 INJECTION AIR HEADER SHUT-OFF VALVE (MANUAL)	P8731E-002/1				
HV-1502H		VE-107 TO VE-112 INJECTION AIR HEADER SHUT-OFF VALVE (MANUAL)	P8731E-002/1				
HV-1502J		MAIN INJECTION AIR HEADER SHUT-OFF VALVE (MANUAL)	P8731E-002/1				
TC-1502		SORBENT SILO HEATER (HTR-101) TEMPERATURE CONTROLLER	P8731E-002/2			SUPPLIED BY HTR-101 VENDOR	
HS-1502		SORBENT SILO STEAM HEATER (HTR-101) HAND SWITCH (ON/OFF)	P8731E-002/2				
dPI-1502		SORBENT FLUIDIZING BLOWER FILTER DIFFERENTIAL PRESSURE INDICATOR	P8731E-002/2				
LSH-1502	DI	SORBENT BLOW POT (ATV-101) LEVEL SWITCH (HIGH)	P8731E-002/2				
LSL-1502	DI	SORBENT BLOW POT (ATV-101) LEVEL SWITCH (LOW)	P8731E-002/2				
FV-1502 ZSO/C-1502	2DO 2DI	SORBENT SILO DISCHARGE VALVE	P8731E-002/2				
PT-1502	AI	SORBENT INJECTION AIR PRESSURE TRANSMITTER	P8731E-002/1				
TT-1502	AI	SORBENT INJECTION AIR TEMPERATURE TRANSMITTER	P8731E-002/1				
TE-1502		SORBENT INJECTION AIR TEMPERATURE ELEMENT	P8731E-002/1				
PCV-1502A		SORBENT INJECTION AIR TO VE-101 TO VE-10 PRESSURE CONTROL VALVE	P8731E-002/1				
PCV-1502B		SORBENT INJECTION AIR TO VE-107 TO VE-11 PRESSURE CONTROL VALVE	P8731E-002/1				

H-5

INSTRUMENT COMPONENT LIST IGT UNIT 1

BY HCD REVISION DATE 9-24-92

TAG NUMBER	I/O TYPE	SERVICE	P&ID NUMBER	PURCHASE ORDER #	MANUFACTURER SUPPLIER	MODEL NUMBER	RANGE
PSV-1502		AR-101 PRESSURE RELIEF VALVE	P8731E-002/2				
FT-1502	AI	SORBENT INJECTION AIR FLOW TRANSMITTER	P8731E-002/1				
FE-1502		SORBENT INJECTION AIR FLOW ELEMENT	P8731E-002/1				
NOZ-1502C		SORBENT INJECTION NOZZLE FRONT WALL FGR DUCT	P8731E-002/2				
NOZ-1502E		SORBENT INJECTION NOZZLE FRONT WALL FGR DUCT	P8731E-002/2				
PSL-1502	DI	SORBENT INJECTION AIR LOW PRESSURE SWITCH (VE-107/112)	P8731E-002/3				
XA-1502	DI	DENSE PHASE FAULT ALARM	P8731E-002/2				
PSL-1503	DI	SORBENT TRANSPORT AIR LOW PRESSURE SWITCH	P8731E-002/3				
FV-1503 ZSO/C-1503	DO DI	SORBENT BLOW POT PRESSURE VENT VALVE	P8731E-002/2				
HV-1503A		PI-1503 ISOLATION VALVE (MANUAL)	P8731E-002/2				
HV-1503B		CM-103 AIR HEADER SHUT-OFF VALVE (MANUAL)	P8731E-002/1				
HV-1503C		MAIN AIR HEADER SHUT-OFF VALVE AFTER AIR RECEIVER (MANUAL)	P8731E-002/1				
PI-1503		SORBENT TRANSPORT AIR PRESSURE INDICATOR	P8731E-002/2				
PSV-1503		SORBENT FLUIDIZING BLOWER (BL-101) PRESSURE RELIEF VALVE	P8731E-002/2				
XV-1503		CM-103 AIR HEADER CHECK VALVE	P8731E-002/1				
FV-1504	DO (2)DI	SORBENT BLOW POT (ATV-101) TRANSPORT AIR VALVE AND PRV	P8731E-002/2				

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TAG NUMBER	I/O TYPE	SERVICE	P&ID NUMBER	PURCHASE ORDER #	MANUFACTURER SUPPLIER	MODEL NUMBER	RANGE
HV-1504A		PI-1504 ISOLATION VALVE (MANUAL)	P8731E-002/2				
HV-1504B		HUMIDIFICATION AIR HEADER SHUT-OFF VALVE (MANUAL)	P8731E-002/1				
HV-1504C		FIL-104 INLET SHUT-OFF VALVE (MANUAL)	P8731E-002/1				
HV-1504D		FIL-104 OUTLET SHUT -OFF VALVE (MANUAL)	P8731E-002/1				
HV-1504E		FIL-104 BY-PASS VALVE (MANUAL)	P8731E-002/1				
HV-1504F		FIL-104 DRAIN VALVE VALVE (MANUAL)	P8731E-002/1				
PI-1504		SORBENT FLUIDIZING BLOWER (BL-101) PRESSURE INDICATOR	P8731E-002/2				
PSH-1504 PSL-1504	DI DI	SORBENT FLUIDIZING BLOWER (BL-101) HIGH & LOW PRESSURE SWITCHES	P8731E-002/2				
PSV-1504		BLOW POT (ATV-101) VENT PRESSURE RELIEF VALVE	P8731E-002/2				
dPI-1504		AIR DRYER INLET FILTER (FIL-104) DIFFERENTIAL PRESSURE INDICATOR	P8731E-002/1				
XA-1504	DI	AIR DRYER (AD-100) FAULT ALARM	P8731E-002/1				
dPI-1505		AIR DRYER OUTLET FILTER (FIL-105) DIFFERENTIAL PRESSURE INDICATOR	P8731E-002/1				
PI-1505		COMPRESSED AIR SUPPLY PRESSURE INDICATOR	P8731E-002/1				
FV-1505A ZSO/C-1505A	2DO 2DI	SORBENT BLOW POT (ATV-101) DISCHARGE VALVE TO TRUCK	P8731E-002/2				
FV-1505B ZSO/C-1505B	2DO 2DI	SORBENT BLOW POT (ATV-101) DISCHARGE VALVE TO BINS	P8731E-002/2				
HV-1505A		FIL-105 INLET SHUT-OFF VALVE (MANUAL)	P8731E-002/1				

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TAG NUMBER	I/O TYPE	SERVICE	P&ID NUMBER	PURCHASE ORDER #	MANUFACTURER SUPPLIER	MODEL NUMBER	RANGE
HV-1505B		FIL-105 OUTLET SHUT-OFF VALVE (MANUAL)	P8731E-002/1				
HV-1505C		FIL-105 BY-PASS VALVE (MANUAL)	P8731E-002/1				
HV-1505D		PI-1505 ISOLATION VALVE (MANUAL)	P8731E-002/1				
XV-1506		TRANSPORT AIR HEADER CHECK VALVE AFTER AIR DRYER	P8731E-002/1				
HV-1506A		TRANSPORT AIR HEADER SHUT-OFF VALVE AFTER AIR DRYER (MANUAL)	P8731E-002/1				
HV-1506B		DRY AIR CROSS OVER VALVE TO EXISTING AIR DRYER SYSTEM (MANUAL)	P8731E-002/1				
HV-1506C		SORBENT SILO (SIL-101) DISCHARGE KNIFE-GATE VALVE	P8731E-002/2				
HV-1506D		PI-1506 ISOLATION VALVE (MANUAL)	P8731E-002/3				
PI-1506		SORBENT TRANSPORT AIR HEADER PRESSURE INDICATOR	P8731E-002/3				
FV-1506 ZSC-1506	DO (2)DI	AIR SLIDE BLOWER VENT VALVE	P8731E-002/2				
HV-1507A		PI-1507A ISOLATION VALVE (MANUAL)	P8731E-002/1				
HV-1507B		PI-1507B ISOLATION VALVE (MANUAL)	P8731E-002/1				
PI-1507A		SORBENT INJECTION AIR PRESSURE REGULATOR OUTLET GAUGE	P8731E-002/1				
PI-1507B		SORBENT INJECTION AIR PRESSURE REGULATOR OUTLET GAUGE	P8731E-002/1				
HV-1509A		STEAM SHUT-OFF VALVE AT 50LB. HEADER FOR HTR-101 (MANUAL)	P8731E-002/2				
HV-1509B		HTR-101 INLET STEAM SHUT-OFF VALVE (MANUAL)	P8731E-002/2				

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TAG NUMBER	I/O TYPE	SERVICE	P&ID NUMBER	PURCHASE ORDER #	MANUFACTURER SUPPLIER	MODEL NUMBER	RANGE
HV-1509C		STN-1509 BLOW DOWN VALVE (MANUAL)	P8731E-002/2				
TRAP-1509		HTR-101 STEAM TRAP	P8731E-002/2				
STN-1509		HTR-101 CONDENSATE LINE STRAINER	P8731E-002/2				
XV-1509		HTR-101 CONDENSATE LINE CHECK VALVE	P8731E-002/2				
FV-1510 ZSO/C-1510	DO (2)DI	SORBENT BIN (BN-101) FILL VALVE WITH LIMIT SWITCH	P8731E-002/2				
HV-1510A		NOZ-1510 SHUT-OFF VALVE (MANUAL)	P8731E-002/2				
HV-1510B		VE-101 OUTLET SHUT-OFF VALVE (MANUAL)	P8731E-002/2				
HV-1510C		PI-1510 ISOLATION VALVE (MANUAL)	P8731E-002/2				
LSH-1510	DI	SORBENT BIN (BN-101) HIGH LEVEL SWITCH	P8731E-002/2				
LSL-1510	DI	SORBENT BIN (BN-101) LOW LEVEL SWITCH	P8731E-002/2				
LSLL-1510	DI	SORBENT BIN (BN-101) LOW-LOW LEVEL ALARM	P8731E-002/2				
HS-1510	AO AI	SORBENT BIN (FD -101) VOLUMETRIC SCREW FEEDER (HOA) SWITCH	P8731E-002/2				
PI-1510		SORBENT INJECTION AIR PRESSURE INDICATOR FOR VE-101	P8731E-002/2				
NOZ-1510		SORRBENT INJECTION NOZZLE (VE-101) ELEVATION 1072'-2"	P8731E-002/2				
HV-1511 ZSC-1511	DI	SORBENT INJECTION AIR MANUAL VALVE W/CLOSED LIMIT SWITCH FOR VE-101	P8731E-002/2				
NOZ-1511		SORBENT INJECTION NOZZLE (VE-101) ELEVATION 1066'-0"	P8731E-002/2				

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TAG NUMBER	I/O TYPE	SERVICE	P&ID NUMBER	PURCHASE ORDER #	MANUFACTURER SUPPLIER	MODEL NUMBER	RANGE
HV-1512		NOZ-1511 SHUT-OFF VALVE (MANUAL)	P8731E-002/2				
LSH-1520	DI	SORBENT BIN (BN-102) HIGH LEVEL SWITCH	P8731E-002/2				
LSL-1520	DI	SORBENT BIN (BN-102) LOW LEVEL SWITCH	P8731E-002/2				
LSLL-1520	DI	SORBENT BIN (BN-102) LOW-LOW LEVEL ALARM	P8731E-002/2				
HS-1520	AO AI	SORBENT BIN (FD -102) VOLUMETRIC SCREW FEEDER (HOA) SWITCH	P8731E-002/2				
HV-1520A		NOZ-1520 SHUT-OFF VALVE (MANUAL)	P8731E-002/2				
HV-1520B		VE-102 OUTLET SHUT-OFF VALVE (MANUAL)	P8731E-002/2				
HV-1520C		PI-1520 ISOLATION VALVE (MANUAL)	P8731E-002/2				
PI-1520		SORBENT INJECTION AIR PRESSURE INDICATOR FOR VE-102	P8731E-002/2				
FV-1520 ZSO/C-1520	DO (2)DI	SORBENT BIN (BN-102) FILL VALVE WITH LIMIT SWITCH	P8731E-002/2				
NOZ-1520		SORBENT INJECTION NOZZEL VE-102 ELEVATION 1072'-2"	P8731E-002/2				
SV-1520	DPS	BN-102 TRANSPORT AIR SOLENOID VALVE	P8731E-002/2				
HV-1521 ZSC-1521	DI	SORBENT INJECTION AIR MANUAL VALVE W/CLOSED LIMIT SWITCH FOR VE-102	P8731E-002/2				
NOZ-1521		SORBENT INJECTION NOZZLE (VE-102) ELEVATION 1066'-0"	P8731E-002/2				
HV-1522		NOZ-1521 SHUT-OFF VALVE (MANUAL)	P8731E-002/2				
LSH-1530	DI	SORBENT BIN (BN-103) HIGH LEVEL SWITCH	P8731E-002/2				

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TAG NUMBER	I/O TYPE	SERVICE	P&ID NUMBER	PURCHASE ORDER #	MANUFACTURER SUPPLIER	MODEL NUMBER	RANGE
LSL-1530	DI	SORBENT BIN (BN-103) LOW LEVEL SWITCH	P8731E-002/2				
LSLL-1530	DI	SORBENT BIN (BN -103) LOW-LOW LEVEL ALARM	P8731E-002/2				
HS-1530	AO AI	SORBENT BIN (FD-103) VOLUMETRIC SCREW FEEDER (HOA) SWITCH	P8731E-002/2				
HV-1530A		NOZ-1530 SHUT -OFF VALVE (MANUAL)	P8731E-002/2				
HV-1530B		VE-103 OUTLET SHUT-OFF VALVE (MANUAL)	P8731E-002/2				
HV-1530C		PI-1530 ISOLATION VALVE (MANUAL)	P8731E-002/2				
FV-1530 ZSO/C-1530	DO (2)DI	SORBENT BIN (BN-103) FILL VALVE WITH LIMIT SWITCH	P8731E-002/2				
PI-1530		SORBENT INJECTION AIR PRESSURE INDICATOR FOR VE-103	P8731E-002/2				
NOZ-1530		SORBENT INJECTION NOZZLE VE-103 ELEVATION 1072'-2"	P8731E-002/2				
SV-1530	DPS	BN-103 TRANSPORT AIR SOLENOID VALVE	P8731E-002/2				
HV-1531 ZSC-1531	DI	SORBENT INJECTION AIR VALVE W/CLOSE LIMIT SWITCH FOR VE-103 (MANUAL)	P8731E-002/2				
NOZ-1531		SORBENT INJECTION NOZZLE VE-103 ELEVATION 1066'-0'	P8731E-002/2				
HV-1532		NOZ-1531 SHUT -OFF VALVE (MANUAL)	P8731E-002/2				
LSH-1540	DI	SORBENT BIN (BN-104) HIGH LEVEL SWITCH	P8731E-002/2				
LSL-1540	DI	SORBENT BIN (BIN-104) LOW LEVEL SWITCH	P8731E-002/2				
LSLL-1540	DI	SORBENT BIN (BN-104) LOW-LOW LEVEL ALARM	P8731E-002/2				

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TAG NUMBER	I/O TYPE	SERVICE	P&ID NUMBER	PURCHASE ORDER #	MANUFACTURER SUPPLIER	MODEL NUMBER	RANGE
HS-1540	AO AI	SORBENT BIN FD-104 VOLUMETRIC SCREW FEEDER (HOA) SWITCH	P8731E-002/2				
HV-1540A		NOZ-1540 SHUT-OFF VALVE (MANUAL)	P8731E-002/2				
HV-1540B		VE-104 OUTLET SHUT-OFF VALVE (MANUAL)	P8731E-002/2				
HV-1540C		PI-1540 ISOLATION VALVE (MANUAL)	P8731E-002/2				
FV-1540 ZSO/C-1540	DO (2)DI	SORBENT BIN (BN-104) FILL VALVE W/LIMIT SWITCH	P8731E-002/2				
PI-1540		SORBENT INJECTION AIR PRESSURE INDICATOR FOR VE-104	P8731E-002/2				
NOZ-1540		SORBENT INJECTION NOZZLE VE-104 ELEV. 1072'-2"	P8731E-002/2				
SV-1540	DPS	BN-104 TRANSPORT AIR SOLENOID VALVE	P8731E-002/2				
NOZ-1541		SORBENT INJECTION NOZZLE VE-104 ELEV. 1066'-0"	P8731E-002/2				
HV-1541 ZSC-1541	DI	SORBENT INJECTION AIR MANUAL VALVE W/CLOSED LIMIT SWITCH FOR VE-104	P8731E-002/2				
HV-1542		NOZ-1541 SHUT-OFF VALVE (MANUAL)	P8731E-002/2				
LSH-1550	DI	SORBENT BIN (BN-105) HIGH LEVEL SWITCH	P8731E-002/2				
LSL-1550	DI	SORBENT BIN (BN-105) LOW LEVEL SWITCH	P8731E-002/2				
LSLL-1550	DI	SORBENT BIN (BN-105) LOW-LOW LEVEL ALARM	P8731E-002/2				
HS-1550	AO AI	SORBENT BIN FD-105 VOLUMETRIC SCREW FEEDER (HOA) SWITCH	P8731E-002/2				
HV-1550A		NOZ-1550 SHUT-OFF VALVE (MANUAL)	P8731E-002/2				

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TAG NUMBER	I/O TYPE	SERVICE	P&ID NUMBER	PURCHASE ORDER #	MANUFACTURER SUPPLIER	MODEL NUMBER	RANGE
HV-1550B		VE-105 OUTLET SHUT-OFF VALVE (MANUAL)	P8731-002/2				
HV-1550C		PI-1550 ISOLATION VALVE (MANUAL)	P8731-002/2				
FV-1550 ZSO/C-1550	DO DI	SORBENT BIN (BN-105 FILL VALVE W/LIMIT SWITCH	P8731-002/2				
PI-1550		SORBENT INJECTION AIR PRESSURE INDICATOR FOR VE-105	P8731E-002/2				
NOZ-1550		SORBENT INJECTION NOZZLE VE-105 ELEV. 1072'-2"	P8731E-002/2				
SV-1550	DPS	BN-105 TRANSPORT AIR SOLENOID VALVE	P8731E-002/2				
HV-1551 ZSC-1551	DI	SORBENT INJECTION AIR MANUAL VALVE W/CLOSED LIMIT SWITCH FOR VE-105	P8731E-002/2				
NOZ-1551		SORBENT INJECTION NOZZLE VE-105 ELEV. 1066'-0"	P8731E-002/2				
HV-1552		NOZ-1551 SHUT-OFF VALVE (MANUAL)	P8731E-002/2				
HV-1553A		FS-101 INLET SHUT-OFF VALVE (MANUAL)	P8731E-002/2		(DELETED)		
HV-1553B		FS-101 BRANCH SHUT-OFF VALVE (MANUAL)	P8731E-002/2				
HV-1553C		NOZ-1501C SHUT-OFF VALVE (MANUAL)	P8731E-002/2				
HV-1553D		FS-101 BRANCH SHUT-OFF VALVE (MANUAL)	P8731-002/2				
HV-1553E		NOZ-1501E SHUT-OFF VALVE (MANUAL)	P8731-002/2				
HV-1553F		FS-101 BRANCH SHUT-OFF VALVE (MANUAL)	P8731-002/2				
HV-1553G		NOZ-1501G SHUT-OFF VALVE (MANUAL)	P8731-002/2				

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TAG NUMBER	I/O TYPE	SERVICE	P&ID NUMBER	PURCHASE ORDER #	MANUFACTURER SUPPLIER	MODEL NUMBER	RANGE
HV-1553H		FS-101 BRANCH SHUT-OFF VALVE (MANUAL)	P8731E-002/2				
HV-1553J		NOZ-1501J SHUT-OFF VALVE (MANUAL)	P8731-002/2				
LSH-1560	DI	SORBENT BIN (BN -106) HIGH LEVEL SWITCH	P8731E-002/2				
LSL-1560	DI	SORBENT BIN (BN-106) LOW LEVEL SWITCH	P8731E-002/2				
LSLL-1560	DI	SORBENT BIN (BN-106) LOW-LOW LEVEL ALARM	P8731E-002/2				
HS-1560	AO AI	SORBENT BIN FD-106 VOLUMETRIC SCREW FEEDER (HOA) SWITCH	P8731E-002/2				
HV-1560A		NOZ-1560 SHUT-OFF VALVE (MANUAL)	P8731-002/2				
HV-1560B		VE-106 OUTLET SHUT-OFF VALVE (MANUAL)	P8731-002/2				
HV-1560C		PI-1560 ISOLATION VALVE (MANUAL)	P8731-002/2				
PI-1560		SORBENT INJECTION AIR PRESSURE INDICATOR FOR VE-106	P8731E-002/2				
FV-1560 ZSO/C-1560	DO (2)DI	SORBENT BIN (BN-106) FILL VALVE W/LIMIT SWITCH	P8731E-002/2				
NOZ-1560		SORBENT INJECTION NOZZLE VE-106 ELEV. 1072'-2"	P8731-002/2				
SV-1560	DPS	BN-106 TRANSPORT AIR SOLENOID VALVE	P8731E-002/2				
HV-1561 ZSC-1561	DI	SORBENT INJECTION AIR MANUAL VALVE W/CLOSED LIMIT SWITCH FOR VE-106	P8731E-002/2				

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TAG NUMBER	I/O TYPE	SERVICE	P&ID NUMBER	PURCHASE ORDER #	MANUFACTURER SUPPLIER	MODEL NUMBER	RANGE
NOZ-1561		SORBENT INJECTION NOZZLE VE-106 ELEV. 1066'-0"	P8731-002/2				
HV-1562		NOZ-1561 SHUT-OFF VALVE (MANUAL)	P8731-002/2				
HV-1564A		FS-102 INLET SHUT-OFF VALVE (MANUAL)	P8731-002/2		(DELETED)		
HV-1564B		FS-102 BRANCH SHUT-OFF VALVE (MANUAL)	P8731-002/2				
HV-1564C		NOZ-1502C SHUT-OFF VALVE (MANUAL)	P8731-002/2				
HV-1564D		FS-102 BRANCH SHUT-OFF VALVE (MANUAL)	P8731-002/2				
HV-1564E		NOZ-1502E SHUT-OFF VALVE (MANUAL)	P8731E-002/2				
LSH-1570	DI	SORBENT BIN (BN-107) HIGH LEVEL SWITCH	P8731E-002/3				
LSL-1570	DI	SORBENT BIN (BIN-107) LOW LEVEL SWITCH	P8731E-002/3				
LSLL-1570	DI	SORBENT BIN (BN-107) LOW-LOW LEVEL ALARM	P8731E-002/3				
HS-1570	AO AI	SORBENT BIN FD-107 VOLUMETRIC SCREW SCREW FEEDER (HOA) SWITCH	P8731E-002/3				
HV-1570A		NOZ-1570 SHUT-OFF VALVE (MANUAL)	P87313-002/3				
HV-1570B		VE-107 OUTLET SHUT-OFF VALVE (MANUAL)	P8731-002/3				
HV-1570C		PI-1570 ISOLATION VALVE (MANUAL)	P8731E-002/3				
PI-1570		SORBENT INJECTION AIR PRESSURE INDICATOR FOR VE-107	P8731E-002/3				
FV-1570 ZSO/C-1570	DO (2)DI	SORBENT BIN (BN-107) FILL VALVE W/LIMIT SWITCH	P8731E-002/3				

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TAG NUMBER	I/O TYPE	SERVICE	P&ID NUMBER	PURCHASE ORDER #	MANUFACTURER SUPPLIER	MODEL NUMBER	RANGE
NOZ-1570		SORBENT INJECTION NOZZLE VE-107 ELEV. 1072"-2"	P8731E-002/3				
SV-1570	DPS	BN-107 TRANSPORT AIR SOLENOID VALVE	P8731E-002/3				
HV-1571 ZSC-1571	DI	SORBENT INJECTION AIR MANUAL VALVE W/CLOSED LIMIT SWITCH FOR VE-107	P8731E-002/3				
NOZ-1571		SORBENT INJECTION NOZZLE VE-107 ELEV. 1066'-0"	P8731E-002/3				
HV-1572		NOZ-1571 SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
LSH-1580	DI	SORBENT BIN (BN-108) HIGH LEVEL SWITCH	P8731E-002/3				
LSL-1580	DI	SORBENT BIN (BN-108) LOW LEVEL SWITCH	P8731E-002/3				
LSLL-1580	DI	SORBENT BIN (BN-108) LOW-LOW LEVEL ALARM	P8731E-002/3				
HS-1580	AO AI	SORBENT BIN FD-108 VOLUMETRIC SCREW FEEDER (HOA) SWITCH	P8731E-002/3				
HV-1580A		NOZ-1580 SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
HV-1580B		VE-108 OUTLET SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
HV-1580C		PI-1580 ISOLATION VALVE (MANUAL)	P8731E-002/3				
PI-1580		SORBENT INJECTION AIR PRESSURE INDICATOR FOR VE-108	P8731E-002/3				
FV-1580 ZSO/C-1580	DO (2)DI	SORBENT BIN (BN-108) FILL VALVE W/LIMIT SWITCH.	P8731-002/3				
NOZ-1580		SORBENT INJECTION NOZZLE VE-108 ELEV. 1072'-2"	P8731E-002/3				
SV-1580	DPS	BN-108 TRANSPORT AIR SOLENOID VALVE	P8731E-002/3				

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HV-1581 ZSC-1581	DI	SORBENT INJECTION AIR MANUAL VALVE W/CLOSED LIMIT SWITCH FOR VE-108	P8731E-002/3				
NOZ-1581		SORBENT INJECTION NOZZLE VE-108 ELEV. 1066'-0"	P8731E-002/3				
HV-1582		NOZ-1581 SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
LSH-1590	DI	SORBENT BIN (BN-109) HIGH LEVEL SWITCH	P8731E-002/3				
LSL-1590	DI	SORBENT BIN (BN-109) LOW LEVEL SWITCH	P8731E-002/3				
LSLL-1590	DI	SORBENT BIN (BN-109) LOW-LOW LEVEL ALARM	P8731E-002/3				
HS-1590	AO AI	SORBENT BIN FD-109 VOLUMETRIC SCREW FEEDER (HOA) SWITCH	P8731E-002/3				
HV-1590A		SORBENT BIN NOZ-1590 SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
HV-1590B		VE-109 OUTLET SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
HV-1590C		PI-1590 ISOLATION VALVE (MANUAL)	P8731E-002/3				
PI-1590		SORBENT INJECTION AIR PRESSURE INDICATOR FOR VE-109	P8731E-002/3				
FV-1590 ZSO/C-1590	DO (2)DI	SORBENT BIN (BN-109) FILL VALVE W/LIMIT SWITCH	P8731E-002/3				
NOZ-1590		SORBENT INJECTION NOZZLE VE-109 ELEV. 1072'-2"	P8731E-002/3				
SV-1590	DPS	BN-109 TRANSPORT AIR SOLENOID VALVE	P8731E-002/3				
HV-1591 ZSC-1591	DI	SORBENT INJECTION AIR MANUAL VALVE W/CLOSED LIMIT SWITCH FOR VE-109	P8731E-002/3				
NOZ-1591		SORBENT INJECTION NOZZLE VE-109 ELEV. 1066'-0"	P8731E-002/3				

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HV-1592		NOZ-1591 SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
LSH-1600	DI	SORBENT BIN (BN-110) HIGH LEVEL SWITCH	P8731E-002/3				
LSL-1600	DI	SORBENT BIN (BN-110) LOW LEVEL SWITCH	P8731E-002/3				
LSLL-1600	DI	SORBENT BIN (BN-110) LOW-LOW LEVEL ALARM	P8731E-002/3				
HS-1600	AO AI	SORBENT BIN FD -110 VOLUMERTIC SCREW FEEDER (HOA) SWITCH	P8731E-002/3				
HV-1600A		NOZ-1600 SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
HV-1600B		VE-110 OUTLET SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
HV-1600C		PI-1600 ISOLATION VALVE (MANUAL)	P8731E-002/3				
PI-1600		SORBENT INJECTION AIR PRESSURE INDICATOR FOR VE-110	P8731E-002/3				
FV-1600 ZSO/C-1600	DO (2)DI	SORBENT BIN (BN-111) FILL VALVE W/LIMIT SWITCH	P8731E-002/3				
NOZ-1600		SORBENT INJECTION NOZZLE VE-110 ELEV. 1072'-2"	P8731E-002/3				
SV-1600	DPS	BN-110 TRANSPORT AIR SOLENOID VALVE	P8731E-002/3				
HV-1601 ZSC-1601	DI	SORBENT INJECTION AIR MANUAL VALVE W/CLOSED LIMIT SWITCH FOR VE-110	P8731E-002/3				
NOZ-1601		SORBENT INJECTION NOZZLE VE-110 ELEV. 1066' 0"	P8731-002/3				
HV-1602		NOZ-1601 SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
LSH-1610	DI	SORBENT BIN (BN-111) HIGH LEVEL SWITCH	P8731E-002/3				

INSTRUMENT COMPONENT LIST IGT UNIT 1

BY HCD REVISION DATE 9-24-92

TAG NUMBER	I/O TYPE	SERVICE	P&ID NUMBER	PURCHASE ORDER #	MANUFACTURER SUPPLIER	MODEL NUMBER	RANGE
LSL-1610	DI	SORBENT BIN (BN-111) LOW LEVEL SWITCH	P8731E-002/3				
LSLL-1610	DI	SORBENT BIN (BN-111) LOW-LOW LEVEL ALARM	P8731E-002/3				
HS-1610	AO AI	SORBENT BIN FD-111 VOLUMETRIC SCREW FEEDER (HOA) SWTICH	P8731E-002/3				
HV-1610A		NOZ-1610 SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
HV-1610B		VE-111 OUTLET SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
HV-1610C		PI-1610 ISOLATION VALVE (MANUAL)	P8731E-002/3				
PI-1610		SORBENT INJECTION AIR PRESSURE INDICATOR FOR VE-111	P8731E-002/3				
FV-1610 ZSO/C-1600	DO (2)DI	SORBENT BIN (BN-111) FILL VALVE W/LIMIT SWITCH	P8731E-002/3				
NOZ-1610		SORBENT INJECTION NOZZLE VE-111 ELEV. 1072'-2'	P8731E-002/3				
SV-1610	DPS	BN-111 TRANSPORT AIR SOLENOID VALVE	P8731E-002/3				
HV-1611 ZSC-1611	DI	SORBENT INJECTION AIR MANUAL VALVE W/CLOSED LIMIT SWITCH FOR VE-111	P8731E-002/3				
NOZ-1611		SORBENT INJECTION NOZZLE VE-111 ELEV. 1066'-0"	P8731E-002/3				
HV-1612		NOZ-1611 SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
HV-1613A		FS-103 INLET SHUT-OFF VALVE (MANUAL)	P8731E-002/3		(DELETED)		
HV-1613B		FS-103 BRANCH SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
HV-1613C		NOZ-1613C SHUT-OFF VALVE (MANUAL)	P8731E-002/3				

INSTRUMENT COMPONENT LIST IGT UNIT 1

BY HCD REVISION DATE 9-24-92

TAG NUMBER	I/O TYPE	SERVICE	P&ID NUMBER	PURCHASE ORDER #	MANUFACTURER SUPPLIER	MODEL NUMBER	RANGE
HV-1613D		FS-103 BRANCH SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
HV-1613E		NOZ-1613E SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
NOZ-1613C		SORBENT INJECTION NOZZLE REAR WALL FGR DUCT	P8731E-002/3				
NOZ-1613E		SORBENT INJECTION NOZZLE REAR WALL FGR DUCT	P8731E-002/3				
LSH-1620	DI	SORBENT BIN (BN-112) HIGH LEVEL SWITCH	P8731E-002/3				
LSL-1620	DI	SORBENT BIN (BN-112) LOW LEVEL SWITCH	P8731E-002/2				
LSLL-1620	DI	SORBENT BIN (BN-112) LOW-LOW LEVEL ALARM	P8731E-002/3				
HS-1620	AO AI	SORBENT BIN FD-112 VOLUMETRIC SCREW FEEDER (HOA) SWITCH	P8731E-002/3				
HV-1620A		NOZ-1620 SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
HV-1620B		VE-112 OUTLET SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
HV-1620C		PI-1620 ISOLATION VALVE (MANUAL)	P8731E-002/3				
PI-1620		SORBENT INJECTION AIR PRESSURE INDICATOR FOR VE-112	P8731E-002/3				
FV-1620 ZSO/C-1620	DO (2)DI	SORBENT BIN (BN-112) FILL VALVE W/LIMIT SWITCH	P8731E-002/3				
NOZ-1620		SORBENT INJECTION NOZZLE VE-112 ELEV. 1072'-2"	P8731E-002/3				
SV-1620	DPS	BN-112 TRANSPORT AIR SOLENOID VAALVE	P8731E-002/3				
HV-1621 ZSC-1621	DI	SORBENT INJECTION AIR MANUAL VALVE W/CLOSED LIMIT SWITCH FOR VE-112	P8731E-002/3				

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INSTRUMENT COMPONENT LIST IGT UNIT 1

BY HCD REVISION DATE 9-24-92

TAG NUMBER	I/O TYPE	SERVICE	P&ID NUMBER	PURCHASE ORDER #	MANUFACTURER SUPPLIER	MODEL NUMBER	RANGE
NOZ-1621		SORBENT INJECTION NOZZLE VE-112 ELEV. 1066'-0"	P8731E-002/3				
HV-1622		NOZ-1621 SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
HV-1624A		FIL-102 AIR HEADER SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
HV-1624B		FS-104 BRANCH SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
HV-1624C		NOZ-1624C SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
HV-1624D		FS-104 BRANCH SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
HV-1624E		NOZ-1624E SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
NOZ-1624C		SORBENT INJECTION NOZZLE REAR WALL FGR DUCT	P8731E-002/3				
NOZ-1624E		SORBENT INJECTION NOZZLE REAR WALL FGR DUCT	P8731E-002/3				
HV-1630A		PI-1630 ISOLATION VALVE (MANUAL)	P8731E-002/3				
LSH-1630	DI	SORBENT BIN (BN-113) HIGH LEVEL SWITCH	P8731E-002/3				
LSL-1630	DI	SORBENT BIN (BN -113) LOW LEVEL SWITCH	P8731E-002/3				
LSLL-1630	DI	SORBENT BIN (BN -113) LOW-LOW LEVEL ALARM	P8731E-002/3				
HS-1630	AO AI	SORBENT BIN (FD-113) VOLUMETRIC SCREW FEEDER (HOA) SWITCH	P8731E-002/3				
PSL-1630	DI	EDUCTOR AIR LOW PRESSURE SWITCH VE-113	P8731E-002/3				
PI-1630		SORBENT INJECTION AIR PRESSURE INDICATOR FOR VE-113	P8731E-002/3				

INSTRUMENT COMPONENT LIST IGT UNIT 1

BY HCD REVISION DATE 9-24-92

TAG NUMBER	I/O TYPE	SERVICE	P&ID NUMBER	PURCHASE ORDER #	MANUFACTURER SUPPLIER	MODEL NUMBER	RANGE
PSV-1630		FIL-102 PRESSURE RELIEF VALVE	P8731E-002/3				
dPSH-1630	DI	FIL-102 HIGH DIFFERENTIAL PRESSURE SWITCH	P8731E-002/3				
FV-1630 ZSO/C-1630	DO DI	SORBENT BIN (BN-113) FILL VALVE W/LIMIT SWITCH	P8731E-002/3				
PCV-1630		EDUCTOR AIR PRESSURE CONTROL VALVE FOR VE-113	P8731E-002/3				
SV-1630	DPS	BN-113 TRANSPORT AIR SOLENOID VALVE	P8731E-002/3				
XC-1630		FIL-102 BAG CLEANING TIMER FOR SOLENOID VALVE	P8731E-002/3				
HV-1631 ZSC-1631	DI	SORBENT INJECTION AIR MANUAL VALVE W/CLOSED LIMIT SWITCH FOR VE-113	P8731E-002/3				
HS-1631		VENT FILTER BLOWER (BL-102) MOTOR (HOA) SWITCH	P8731E-002/3				
HV-1632A		SPLITTER (FS-105) DUCT NOZZLE SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
HV-1632B		SPLITTER (FS-105) DUCT NOZZLE SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
HV-1632C		SPLITTER (FS-105) DUCT NOZZLE SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
HV-1632D		SPLITTER (FS-105) DUCT NOZZLE SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
HV-1633A		SPLITTER (FS-105) BRANCH SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
HV-1633B		SPLITTER (FS-105) BRANCH SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
HV-1633C		SPLITTER (FS-105) BRANCH SHUT-OFF VALVE (MANUAL)	P8731E-002/3				
HV-1633D		SPLITTER (FS-105) BRANCH SHUT-OFF VALVE (MANUAL)	P8731E-002/3				

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TAG NUMBER	I/O TYPE	SERVICE	P&ID NUMBER	PURCHASE ORDER #	MANUFACTURER SUPPLIER	MODEL NUMBER	RANGE
HV-1633E		SPLITTER (FS-105) INLET SHUT-OFF VALVE (MANUAL)	P8731-002/3				
HS-1640	AO AI	SORBENT BIN (BN -114) VOLUMETRIC SCREW FEEDER (HOA) SWITCH	P8731E-002/4				
HV-1640A		PI-1640 ISOLATION VALVE (MANUAL)	P8731E-002/4				
LSH-1640	DI	BN-114 HIGH LEVEL SWITCH	P8731E-002/4				
LSL-1640	DI	BN-114 LOW LEVEL SWITH	P8731E-002/4				
PCV-1640		EDUCTOR AIR PRESSURE CONTROL VALVE FOR VE-114	P8731E-002/4				
PSL-1640	DI	EDUCTOR AIR LOW PRESSURE SWITCH FOR VE-114	P8731E-002/4				
PI-1640		EDUCTOR AIR PRESSURE INDICATOR FOR VE-114	P8731E-002/4				
HS-1641		BAG BREAKER STATION EXHAUST FAN (BL-103) SWITCH (ON/OFF)	P8731E-002/4				
HV-1641 ZSC-1641	DI	EDUCTOR VE-114 AIR SHUT-OFF VALVE W/CLOSED LIMIT SWITCH	P8731E-002/4				
FV-1642		BBS-114 BAG BREAKER FILTER CLEANING AIR SOLENOID VALVE	P8731E-002/4				
HS-1642		BBS-114 BAG BREAKER FILTER CLEANER AIR SWITCH (ON/OFF)	P8731E-002/4				
HV-1642A		BAG BREAKER STATION (BBS-101) FILTER CLEANING AIR SHUT-OFF VALVE (MAN.)	P8731E-002/4				
HV-1643		METALS SORBENT INJECTOR NOZZLE SHUT-OFF VALVE	P8731E-002/4				
HV-1644		VE-1640 OUTLET SHUT-OFF VALVE	P8731E-002/4				
FV-1650		HUMIDIFICATION PUMP (PMP-101) RECIRCULATING VALVE	P8731E-002/4				

INSTRUMENT COMPONENT LIST IGT UNIT 1

BY HCD REVISION DATE 9-24-92

TAG NUMBER	I/O TYPE	SERVICE	P&ID NUMBER	PURCHASE ORDER #	MANUFACTURER SUPPLIER	MODEL NUMBER	RANGE
HS-1650	DO (2)DI	HUMIDIFICATION BOOSTER PUMP (PMP-101) SWITCH (HOA)	P8731E-002/4				
HV-1650A		HOUSE SERVICE WATER HEADER SHUT-OFF VALVE (MANUAL)	P8731E-002/4				
HV-1650B		HUMIDIFICATION WATER TANK (TK-301) INLET SHUT-OFF VALVE (MANUAL)	P8731E-002/4				
HV-1650C		HUMIDIFICATION WATER TANK (TK-301) OUTLET SHUT-OFF VALVE (MANUAL)	P8731E-002/4				
HV-1650D		HUMIDIFICATION WATER TANK (TK-301) PUMP FEED LINE SHUT-OFF VALVE (MAN.)	P8731E-002/4				
HV-1650E		PI-1650 ISOLATION VALVE (MANUAL)	P8731E-002/4				
HV-1650F		HUMIDIFICATION WATER PUMP (PMP-101) INLET SHUT-OFF VALVE (MANUAL)	P8731E-002/4				
HV-1650G		HUMIDIFICATION WATER PUMP (PMP-101) INLET LINE DRAIN VALVE	P8731E-002/4				
HV-1650H		HUMIDIFICATION WATER PUMP (PMP-101) INLET STRAINER BLOW DOWN VALVE	P8731E-002/4				
HV-1650J		HUMIDIFICATION WATER PUMP (PMP-101) OUTLET SHUT-OFF VALVE	P8731E-002/4				
HV-1650K		PI-1650B ISOLATION VALVE (MANUAL)	P8731E-002/4				
FE/FT-1650	AI	HUMIDIFICATION WATER FLOW INTEGRAL ORIFICE FLOW TRANSMITTER	P8731E-002/4				
FQI-1650		HUMIDIFICATION WATER FLOW TOTALIZER	P8731E-002/4				
LSHL-1650	DI	TK-101 HI/LO LEVEL SWITCH	P8731E-002/4				
PI-1650A		HUMIDIFICATION PUMP (PMP-101) INLET WATER PRESSURE INDICATOR	P8731E-002/4				
PI-1650B		HUMIDIFICATION PUMP (PMP-101) OUTLET WATER PRESSURE INDICATOR	P8731E-002/4				

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INSTRUMENT COMPONENT LIST IGT UNIT 1

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TAG NUMBER	I/O TYPE	SERVICE	P&ID NUMBER	PURCHASE ORDER #	MANUFACTURER SUPPLIER	MODEL NUMBER	RANGE
STN-1650		HUMIDIFICATION PUMP (PMP-101) INLET STRAINER	P8731E-002/4				
TY-1650	AI	HUMIDIFICATION DUCT THERMOCOUPLE (SUM/ AVG. A,B,C,&D)	P8731E-002/4				
TE-1650A		HUMIDIFICATION DUCT THERMOCOUPLE A	P8731E-002/4				
TE-1650B		HUMIDIFICATION DUCT THERMOCOUPLE B	P8731E-002/4				
TE-1650C	AI	HUMIDIFICATION DUCT THERMOCOUPLE C	P8731E-002/4				
TE-1650D		HUMIDIFICATION DUCT THERMOCOUPLE D	P8731E-002/4				
XV-1650		HUMIDIFCATION WATER PUMP (PMP-101) OUTLET CHEDK VALVE	P8731E-002/4				
FE-1651		HUMIDIFICATION AIR FLOW ELEMENT	P8731E-002/4				
FT-1651		HUMIDIFICATION AIR FLOW TRANSMITTER	P8731E-002/4				
FCV-1651 ZSC-1651	DI AO	HUMIDIFICATION SYSTEM AIR FLOW CONTROL VALVE W/LIMIT SWITCH	P8731E-002/4				
HV-1651A		PT-1651 ISOLATION VALVE (MANUAL)	P8731E-002/4				
HV-1651B		PCV-1651 AIR SHUT-OFF VALVE (MANUAL)	P8731E-002/4				
HV-1651C		FCV-1651 INLET SHUT-OFF VALVE (MANUAL)	P8731E-002/4				
HV-1651D		FCV-1651 BY-PASS VALVE (MANUAL)	P8731E-002/4				
HV-1651E		FCV-1651 OUTLET SHUT-OFF VALVE (MANUAL)	P8731E-002/4				
HV-1651F		STN-1651 BLOW DOWN VALVE (MANUAL)	P8731E-002/4				

INSTRUMENT COMPONENT LIST IGT UNIT 1

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TAG NUMBER	I/O TYPE	SERVICE	P&ID NUMBER	PURCHASE ORDER #	MANUFACTURER SUPPLIER	MODEL NUMBER	RANGE
HV-1651G		FT-1651 ISOLATION VALVE	P8731E-002/4				
HV-1651H		FT-1651 ISOLATION VALVE	P8731E-002/4				
PCV-1651		INSTRUMENT AIR FILTER REGULATOR WITH GAGE FOR FCV-1651	P8731E-002/4				
PT-1651	AI	HUMIDIFICATION SYSTEM AIR PRESSURE TRANSMITTER	P8731E-002/4				
FI-1651		HUMIDIFICATION LANCE (ISL-101) WATER FLOW INDICATOR	P8731E-002/4				
STN-1651		HUMIDIFICATION SYSTEM AIR LINE STRAINER	P8731E-002/4				
XV-1651A		HUMIDIFICATION LANCE (IJL-101) WATER CHECK VALVE	P8731E-002/4				
XV-1651B		HUMIDIFICATION LANCE (IJL-101) PURGE AIR CHECK VALVE	P8731E-002/4				
FI-1652		HUMIDIFICATION LANCE (IJL-102) WATER FLOW INDICATOR	P8731-002/4				
FV-1652	DO	HUMIDIFICATION SYSTEM LANCE PURGE AIR VALVE	P8731E-002/4				
HV-1652A		PT-1652 ISOLATION VALVE (MANUAL)	P8731E-002/4				
HV-1652B		PCV-1652 AIR SHUT OFF VALVE (MANUAL)	P8731E-002/4				
HV-1652C		FCV-1652 INLET SHUT-OFF VALVE (MANUAL)	P8731E-002/4				
HV-1652D		FCV-1652 BY-PASS VALVE (MANUAL)	P8731E-002/4				
HV-1652E		FCV-1652 OUTLET SHUT-OFF VALVE (MANUAL)	P8731E-002/4				
HV-1652F		HUMIDIFICATION WATER LINE SHUT-OFF VALVE (MANUAL)	P8731E-002/4				

BY HCD REVISION DATE 9-24-92

TAG NUMBER	I/O TYPE	SERVICE	P&ID NUMBER	PURCHASE ORDER #	MANUFACTURER SUPPLIER	MODEL NUMBER	RANGE
HV-1652G		STN-1652 BLOW DOWN VALVE (MANUAL)	P8731-002/4				
STN-1652		HUMIDIFICATION SYSTEM LANCE WATER STRAINER	P8731E-002/4				
PCV-1652		INSTRUMENT AIR FILTER REGULATOR FOR FCV-1652	P8731E-002/4				
FCV-1652 ZSC-1652	AO DI	HUMIDIFICATION SYSTEM WATER CONTROL VALVE W/LIMIT SWITCH	P8731E-002/4				
PT-1652	AI	HUMIDIFICATION SYSTEM WATER PRESSURE TRANSMITTER	P8731E-002/4				
XV-1652A		HUMIDIFICATION LANCE (IJL-102) WATER CHECK VALVE	P8731E-002/4				
XV-1652B		HUMIDIFICATION LANCE (IJL-102) PURGE AIR CHECK VALVE	P8731E-002/4				
FV-1653	DO	HUMIDIFICATION SYSTEM WATER SHUT-OFF VALVE	P8731E-002/4				
BV-1510A-THRU AK		SORBENT BOOSTER VALVES BETWEEN ATV-101 AND BN-101	P8731E-002/2				
BV-1520		BN-102 SORBENT BOOSTER VALVE	P8731E-002/2				
BV-1530		BN-103 SORBENT BOOSTER VALVE	P8731E-002/2				
BV-1540		BN-104 SORBENT BOOSTER VALVE	P8731E-002/2				
BV-1550		BN-105 SORBENT BOOSTER VALVE	P8731E-001/22				
BV-1560		BN-106 SORBENT BOOSTER VALVE	P8731E-002/2				
BV-1570A THRU W		SORBENT BOOSTER VALVES FROM FRONT TO REAR WALL BINS BN-106 TO BN-107	P8731E-002/3				
BV-1580		BN-108 SORBENT BOOSTER VALVE	P8731E-002/3				

INSTRUMENT COMPONENT LIST IGT UNIT 1

BY HCD REVISION DATE 9-24-92

TAG NUMBER	I/O TYPE	SERVICE	P&ID NUMBER	PURCHASE ORDER #	MANUFACTURER SUPPLIER	MODEL NUMBER	RANGE
BV-1590		BN-109 SORBENT BOOSTER VALVE	P8731E-001/3				
BV-1600		BN-110 SORBENT BOOSTER VALVE	P8731E-002/3				
BV-1610		BN-111 SORBENT BOOSTER VALVE	P8731E-002/3				
BV-1620		BN-112 SORBENT BOOSTER VALVE	P8731E-002/3				
BV-1630A		SORBENT BOOSTER VALVE BETWEEN BN-112 AND BN-113	P8731E-002/3				
BV-1630B		BN-113 SORBENT BOOSTER VALVE	P8731E-002/3				

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APPENDIX I. Formal Circuit List

APPENDIX I. Formal Circuit List

NOTES:

1. The following attachments and computer output are included as a part of this Raceway List:

   - Raceway size list
   - Raceway length summary by material

   Note: The conduit material shall be as specified. The raceway lengths as listed are estimates for bid purposes only. the unit adjustment prices requested in the specification shall be used to adjust the lump sum price based on the actual raceway lengths required.

   - Circuit List Description
   - Formal Circuit List

2. The formal Circuit List contains circuits for control. Instrument and power and are prefixed by the letters "C", "E", and "P", respectively.

3. The formal Circuit List describes the cable required for installation to equipment and devices as shown on the raceway composite drawings.

4. The formal Circuit List does not include cable required for lighting. Refer to drawing BV-8612-303 for this work.

NO	DATE	Revisions & Record of Issue	By	Chk	App	Flm

EER Consulting Engineers	IGT Emission Reduction Testing System
Engineer / Drawn	CIRCUIT LIST
Checked / Date	

Project	Drawing No.	Rev
	E8731-003	0
Code		
Area		

Energy and
Environmental
Research Corporation
PROJECT 8731

DATE 9/16/92
Rev. 0

EER - IGT
OLMSTED WASTE TO ENERGY FACILITY

CIRCUIT & CABLE LENGTH SUMMARY

CN.	SIZE	TYPE	NO. CABLE	NO. CKT.	CKT. LENGTH	CBL LENGTH
1	4/0	GND (Bare)	1	1	250	250'
1	350	B	10	2	50	500'
1	3/0	B	4	1	125	500'
1	3/0	B	3	1	30	90'
1	2	B	6	2	70	750'
4	10	C	1	8	120	1000'
4	12	C	1	15		1000
3	12	C	1	25		1200
7	14	D	1	18		2500
5	14	D	1	15		3000
3	14	D	1	20		2500'
2	14	D	1	102		10,000

Energy and
Environmental
Research Corporation
PROJECT 8731

DATE 9/16/92
Rev. C

EER - IGT
OLMSTED WASTE TO ENERGY FACILITY

CABLE LIST

CN.	SIZE	TYPE	AREA	REMARK
1	2	B	0.1320	600V POWER
1	4	B	0.1020	600V POWER
1	1/0	G	0.1960	GROUND
1	4/0	B	0.3740	600V POWER
350		B	0.6850	600V POWER
3	12	C	0.1130	600V POWER
2	14	D	0.0680	CONTROL
2	16	E	0.0550	INSTRUMENT
2	16	KX	0.0530	THERMOCOUPLE EXT
3	14	D	0.0930	CONTROL
4	10	C	0.2460	600V POWER
4	12	C	0.1770	600V POWER
5	14	D	0.1320	CONTROL
7	14	D	0.1560	CONTROL
4	16	E		INSTRUMENT
4	4/0	G		BARE COPPER

Instrument cable to be twisted
Shield pair with gnd with overall foil shield

EER - IGT
OLMSTED WASTE TO ENERGY FACILITY
UNIT #1

Rv	Circuit No.	S	From Equipment/Desc 1/ Desc 2/Device	To Equipment/Desc1/ Desc 2/Device	- Cable Data - No Cn Siz Type	Routing
0	P3839	N	MSC-1 Sootblower Motor Starter Cabinet 1	SB-21 IR Sootblower F	1 4 12 C	R-0108 PB-07 R-0112

Status
N - Not Used

From
Indicates The Equipment Or Device At Which The Circuit Originates

To
Indicates The Equipment Or Device At Which The Circuit Terminates

Circuit Number
Sequence Number

Circuit Type
C - Control
E - Instrument
P - Power

Revision (Per Circuit)
Indicates The Revision Number Of The Last Change To The Individual Circuit

Routing
See Raceway List Description

Type
A
B
C
D
E
F
G
H
Refer To The Cable List

Size
Size Of Individual Conductors Number Indicated Is Awg Or Mcm

Conductors
Indicates The Number Of Conductors In An Overall Cable Assembly

Cables
Indicates The Number Of Overall Cable Assemblies To Be Installed

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NO	DATE		By	Chk	App	Flm

EER Consulting Engineers

Engineer | Drawn
Checked | Date

IGT Emission Reduction Testing System

CIRCUIT LIST DESCRIPTION

Project Drawing No.: E8731-003

Rev: 0

Code

Area

EER - IGT
OLMSTED WASTE TO ENERGY FACILITY
FORMAL CIRCUIT LIST

Revision Date: 9-29-92

REV	CIRCUIT NO. S	FROM EQUIPMENT/DESC 1/ DESC 2/DEVICE	TO EQUIPMENT/DESC 1/ DESC 2/DEVICE	CABLE DATA				ROUTING
				NO	CN	SIZ	TYP	
0	C001	LAH-1501 SORBENT SILO ENCLCOSURE	LSH-1501 TOP OF SORBENT SILO	1	2	14	D	R001 PB-101 R066 TB-116 R058
0	C002	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSLL-1501 SORBENT SILO LOW LOW LEVEL SWITCH	1	2	14	D	C.T.#A C.T.#F R011 PB-101 R004
0	C003	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	FV-1501A SORBENT SILO AIR SLIDE CONTRO VALVE A FOR AS-101A & D	1	2	14	D	C.T.#A C.T.#F R011 PB-101 R003 PB-112 R087
0	C004	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	FV-1501B SORBENT SILO AIR SLIDE CONTRO VALVE B FOR AS-101B & E	1	2	14	D	C.T.#A C.T.#F R011 PB-101 R003 PB-112 R088
0	C005	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	FV-1501C SORBENT SILO AIR SLIDE CONTRO VALVE C FOR AS-101C & F	1	2	14	D	C.T.#A C.T.#F R011 PB-101 R003 PB-112 R089
0	C006	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	XA-1502 DENSE PHASE SYSTEM FAULT ALARM	1	2	14	D	VIA EXISTING FLOOR DUCT
0	C007	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSL/LSH-1650 TK-101 HIGH LEVEL SWITCH	1	5	14	D	C.T.#A R064 PB-103 R085 R099
0	C008	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1501 HOA SWITCH SORBENT FLUIDIZING AIR BLOWER	1	5	14	D	C.T.#A C.T.#F R011 PB-101 R006

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REV	CIRCUIT NO. S	FROM EQUIPMENT/DESC 1/ DESC 2/DEVICE	TO EQUIPMENT/DESC 1/ DESC 2/DEVICE	CABLE DATA				ROUTING
				NO	CN	SIZ	TYP	
0	C009	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	MCC-6 MOTOR CONTROL CENTER HS-1501	1	2	14	D	VIA EXISTING CONTROL ROOM CABLE TRAY
0	C010	MCC-6 MOTOR CONTROL CENTER HS-1501	HS-1501 HOA SWITCH SORBENT FLUIDIZING AIR BLOWER	1	2	14	D	C.T.#A C.T.#F R011 PB-101 R006
0	C011	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	PSL-1501 SORBENT INJECTION AIR LOW PRESSURE SWITCH	1	2	14	D	C.T.# A C.T.#B C.T.#D R061 PB-110 R091
0	C012	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	FV-1505A TRANSPORTER OUTLET VALVE TRUCK STATION W/ ZSC/ZSO-1505A	1	7	14	D	C.T.#A C.T.#F R071 PB-101 RO73
0	C013	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	1	7	14	D	INTERFACING CABLE VIA EXISTING FLOOR DUCT (3 OF THE 13 CIRCUITS)
0	C014	HTR-101 SORBENT SILO STEAM HEATER	HS-1502 SORBENT SILO STEAM HEATER ON/OFF SWITCH	1	5	14	D	R002
0	C015	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	LSH-1502 SORBENT TRANSPORTER LEVEL SWITCH HIGH	1	2	14	D	C.T.#A C.T.#F R011 PB-101 R007 TB-115
0	C016	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	LSL-1502 SORBENT TRANSPORTER LEVEL SWITCH LOW	1	2	14	D	C.T.#A C.T.#F R011 PB-101 R007 TB-115

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				NO	CN	SIZ	TYP	
0	C017	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	FV-1502 SORBENT SILO DISCHARGE CONTROL VALVE W/ZSC & ZSO-1502	1	7	14	D	C.T.#A C.T.#F R071 PB-101 R070
0	C018	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	PSL-1502 SORBENT INJECTION AIR LOW PRESSURE SWITCH (VE-107/113)	1	2	14	D	C.T.#A C.T.#C C.T.#E R062 PB-109 R092
0	C019	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	PSL-1503 SORBENT TRANSPORT AIR LOW PRESSURE SWITCH	1	2	14	D	C.T.#A C.T.#F R011 PB-101 R065
0	C020	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	FV-1503 SORBENT TRANSPORTER VENT VALVE W/ZSC & ZSO-1503 (ATV-101)	1	7	14	D	C.T. #A C.T.#F R071 PB-101 R073
0	C021	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	FV-1504 SORBENT TRANSPORT AIR CONTROL VALVE & PRV W/ZSC & ZSO-1504	1	7	14	D	C.T. #A C.T.#F R071 PB-101 R070
0	C022	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	FV-1505B SORBENT TRANSPORTER DISCHARGE CONTROL VALVE W/ZSC & ZSO-1505B	1	7	14	D	C.T. #A C.T.#F R071 PB-101 R073
0	C023	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	FV-1510 SORBENT BIN-101 CONTROL VALVE W/ZSC & ZSO-1510	1	5	14	D	C.T. #A C.T.#B C.T. #D R061 PB-110 R048 TB-101

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				NO	CN	SIZ	TYP		
0	C024	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSH-1510 SORBENT BIN - 101 HIGH LEVEL SWITCH	1	2	14	D	C.T. #A	C.T.#B C.T. #D R046 PB-110 R048 TB-101
0	C025	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSL-1510 SORBENT BIN-101 LOW LEVEL SWITCH	1	2	14	D	C.T. #A	C.T.#B C.T. #D R046 PB-110 R048 TB-101
0	C026	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSLL-1510 SORBENT BIN - 101 LOW -LOW LEVEL ALARM	1	2	14	D	C.T. #A	C.T.#B C.T. #D R046 PB-110 R048 TB-101
0	C027	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HV-1511 SORBENT INJECTION AIR VALVE W/ ZSC-1511 FOR VE-101	1	2	14	D	C.T. #A	C.T.#B C.T. #D R061 PB-110 R048 TB-101
0	C028	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	FV-1520 SORBENT BIN -102 CONTROL VALVE W/ZSC & ZSO-1520	1	5	14	D	C.T. #A	C.T.#B C.T. #D R061 PB-110 R049 TB-102
0	C029	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSH-1520 SORBENT BIN - 102 HIGH LEVEL SWITCH	1	2	14	D	C.T. #A	C.T.#B C.T. #D R046 PB-110 R049 TB-102
0	C030	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSL-1520 SORBENT BIN - 102 LOW LEVEL SWITCH	1	2	14	D	C.T. #A	C.T.#B C.T. #D R046 PB-110 R049 TB-102
0	C031	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSLL-1520 SORBENT BIN - 102 LOW -LOW LEVEL ALARM	1	2	14	D	C.T. #A	C.T.#B C.T. #D R046 PB-110 R049 TB-102

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				NO	CN	SIZ	TYP	
0	C032	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HV-1521 SORBENT INJECTION AIR VALVE -102 W/ ZSC-1521 FOR VE-102	1	2	14	D	C.T. #A C.T.#B C.T. #D R061 PB-110 R049 TB-102
0	C033	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	FV-1530 SORBENT BIN -103 CONTROL VALVE W/ZSC & ZSO-1530	1	5	14	D	C.T. #A C.T.#B C.T. #D R061 PB-110 R050 TB-103
0	C034	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSH-1530 SORBENT BIN - 103 HIGH LEVEL SWITCH	1	2	14	D	C.T. #A C.T.#B C.T. #D R046 PB-110 R050 TB-103
0	C035	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSL-1530 SORBENT BIN - 103 LOW LEVEL SWITCH	1	2	14	D	C.T. #A C.T.#B C.T. #D R046 PB-110 R050 TB-103
0	C036	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSLL-1530 SORBENT BIN - 103 LOW -LOW LEVEL ALARM	1	2	14	D	C.T. #A C.T.#B C.T. #D R046 PB-110 R050 TB-103
0	C037	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HV-1531 SORBENT INJECTION AIR L VALVE W/ ZSC-1531 FOR VE-103	1	2	14	D	C.T. #A C.T.#B C.T. #D R061 PB-110 R050 TB-103
0	C038	DENSE PHASE PLC CONTROL SYSTEM	FV-1540 SORBENT BIN -104 CONTROL VALVE W/ZSC & ZSO-1540	1	5	14	D	C.T. #A C.T.#B C.T. #D R061 PB-110 R051 TB-104
0	C039	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSH-1540 SORBENT BIN - 104 HIGH LEVEL SWITCH	1	2	14	D	C.T. #A C.T.#B C.T. #D R046 PB-110 R051 TB-104

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				NO	CN	SIZ	TYP	
0	C040	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSL-1540 SORBENT BIN - 104 LOW LEVEL SWITCH	1	2	14	D	C.T. #A C.T.#B C.T. #D R046 PB-110 R051 TB-104
0	C041	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSLL-1540 SORBENT BIN - 104 LOW-LOW LEVEL ALARM	1	2	14	D	C.T. #A C.T.#B C.T. #D R046 PB-110 R051 TB-104
0	C042	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HV-1541 SORBENT INJECTION AIR VALVE W/ ZSC-1541 FOR VE-104	1	2	14	D	C.T. #A C.T.#B C.T. #D R061 PB-110 R051 TB-104
0	C043	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	FV-1550 SORBENT BIN -105 CONTROL VALVE W/ZSC & ZSO-1550	1	5	14	D	C.T. #A C.T.#B C.T. #D R061 PB-110 R052 TB-105
0	C044	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSH-1550 SORBENT BIN - 105 HIGH LEVEL SWITCH	1	2	14	D	C.T. #A C.T.#B C.T. #D R046 PB-110 R052 TB-105
0	C045	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSL-1550 SORBENT BIN- 105 LOW LEVEL SWITCH	1	2	14	D	C.T. #A C.T.#B C.T. #D R046 PB-110 R052 TB-105
0	C046	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSLL-1550 SORBENT BIN - 105 LOW -LOW LEVEL ALARM	1	2	14	D	C.T. #A C.T.#B C.T. #D R046 PB-110 R052 TB-105
0	C047	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HV-1551 SORBENT INJECTION AIR VALVE W/ ZSC-1551 FOR VE-105	1	2	14	D	C.T. #A C.T.#B C.T. #D R061 PB-110 R052 TB-105

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REV	CIRCUIT NO. S	FROM EQUIPMENT/DESC 1/ DESC 2/DEVICE	TO EQUIPMENT/DESC 1/ DESC 2/DEVICE	CABLE DATA				ROUTING
				NO	CN	SIZ	TYP	
0	C048	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	FV-1560 SORBENT BIN -106 CONTROL VALVE W/ZSC- & ZSO1560	1	5	14	D	C.T. #A C.T.#B C.T. #D R061 PB-110 R053 TB-106
0	C049	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSH-1560 SORBENT BIN-106 HIGH LEVEL SWITCH	1	2	14	D	C.T. #A C.T.#B C.T. #D R046 PB-110 R053 TB-106
0	C050	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSL-1560 SORBENT BIN-106 LOW LEVEL SWITCH	1	2	14	D	C.T. #A C.T.#B C.T. #D R046 PB-110 R053 TB-106
0	C051	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSLL-1560 SORBENT BIN - 106 LOW -LOW LEVEL ALARM	1	2	14	D	C.T. #A C.T.#B C.T. #D R046 PB-110 R053 TB-106
0	C052	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HV-1561 SORBENT INJECTION AIR VALVE W/ ZSC-1561 FOR VE-106	1	2	14	D	C.T. #A C.T.#B C.T. #D R061 PB-110 R053 TB-106
0	C053	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	FV-1570 SORBENT BIN-107 CONTROL VALVE W/ZSC & ZSO-1570	1	7	14	D	C.T. #A C.T.#C C.T. #E R062 PB-109 R039 TB-107
0	C054	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSH-1570 SORBENT BIN-107 HIGH LEVEL SWITCH	1	2	14	D	C.T. #A C.T.#C C.T. #E R036 PB-109 R039 TB-107
0	C055	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSL-1570 SORBENT BIN - 107 LOW LEVEL SWITCH	1	2	14	D	C.T. #A C.T.#C C.T. #E R036 PB-109 R039 TB-107

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				NO	CN	SIZ	TYP	
0	C056	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSLL-1570 SORBENT BIN - 107 LOW -LOW LEVEL ALARM	1	2	14	D	C.T. #A C.T.#C C.T. #E R036 PB-109 R039 TB-107
0	C057	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HV-1571 SORBENT INJECTION AIR VALVE W/ ZSC-1571 FOR VE-107	1	2	14	D	C.T. #A C.T.#C C.T. #E R062 PB-109 R039 TB-107
0	C058	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	FV-1580 SORBENT BIN -108 CONTROL VALVE W/ZSC & ZSO-1580	1	7	14	D	C.T. #A C.T.#C C.T. #E R062 PB-109 R040 TB-107
0	C059	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSH-1580 SORBENT BIN-108 HIGH LEVEL SWITCH	1	2	14	D	C.T. #A C.T.#C C.T. #E R036 PB-109 R040 TB-108
0	C060	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSL-1580 SORBENT BIN - 108 LOW LEVEL SWITCH	1	2	14	D	C.T. #A C.T.#C C.T. #E R036 PB-109 R040 TB-108
0	C061	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSLL-1580 SORBENT BIN - 108 LOW -LOW LEVEL ALARM	1	2	14	D	C.T. #A C.T.#C C.T. #E R036 PB-109 R040 TB-108
0	C062	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HV-1581 SORBENT INJECTION AIR VALVE W/ ZSC-1581 FOR VE-108	1	2	14	D	C.T. #A C.T.#C C.T. #E R062 PB-109 R040 TB-108
0	C063	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	FV-1590 SORBENT BIN -109 CONTROL VALVE W/ZSC & ZSO-1590	1	7	14	D	C.T. #A C.T.#C C.T. #E R062 PB-109 R041 TB-109

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				NO	CN	SIZ	TYP	
0	C064	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSH-1590 SORBENT BIN-109 HIGH LEVEL SWITCH	1	2	14	D	C.T. #A C.T.#C C.T. #E R036 PB-109 R041 TB-109
0	C065	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSL-1590 SORBENT BIN - 109 LOW LEVEL SWITCH	1	2	14	D	C.T. #A C.T.#C C.T. #E R036 PB-109 R041 TB-109
0	C066	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSLL-1590 SORBENT BIN-109 LOW -LOW LEVEL ALARM	1	2	14	D	C.T. #A C.T.#C C.T. #E R036 PB-109 R041 TB-109
0	C067	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HV-1591 SORBENT INJECTION AIR VALVE W/ ZSC-1591 FOR VE-109	1	2	14	D	C.T. #A C.T.#C C.T. #E R062 PB-109 R041 TB-109
0	C068	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	FV-1600 SORBENT BIN -110 CONTROL VALVE W/ZSC & ZSO-1600	1	5	14	D	C.T. #A C.T.#C C.T. #E R062 PB-109 R042 TB-110
0	C069	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSH-1600 SORBENT BIN - 110 HIGH LEVEL SWITCH	1	2	14	D	C.T. #A C.T.#C C.T. #E R036 PB-109 R042 TB-110
0	C070	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSL-1600 SORBENT BIN - 110 LOW LEVEL SWITCH	1	2	14	D	C.T. #A C.T.#C C.T. #E R036 PB-109 R042 TB-110
0	C071	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSLL-1600 SORBENT BIN-110 LOW -LOW LEVEL ALARM	1	2	14	D	C.T. #A C.T.#C C.T. #E R036 PB-109 R042 TB-110

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				NO	CN	SIZ	TYP	
0	C072	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HV-1601 SORBENT INJECTION AIR VALVE W/ ZSC-1601 FOR VE-110	1	2	14	D	C.T. #A C.T.#C C.T. #E R062 PB-109 R042 TB-110
0	C073	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	FV-1610 SORBENT BIN -111 CONTROL VALVE W/ZSC & ZSO-1610	1	5	14	D	C.T. #A C.T.#C C.T. #E R062 PB-109 R043 TB-111
0	C074	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSH-1610 SORBENT BIN - 111 HIGH LEVEL SWITCH	1	2	14	D	C.T. #A C.T.#C C.T. #E R062 PB-109 R043 TB-111
0	C075	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSL-1610 SORBENT BIN - 111 LOW LEVEL SWITCH	1	2	14	D	C.T. #A C.T.#C C.T. #E R062 PB-109 R043 TB-111
0	C076	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSLL-1610 SORBENT BIN - 111 LOW SWITCH LEVEL ALARM	1	2	14	D	C.T. #A C.T.#C C.T. #E R036 PB-109 R043 TB-111
0	C077	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HV-1611 SORBENT INJECTION AIR VALVE W/ ZSC-1611 FOR VE-111	1	2	14	D	C.T. #A C.T.#C C.T. #E R062 PB-109 R043 TB-111
0	C078	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	FV-1620 SORBENT BIN -112 CONTROL VALVE W/ZSC & ZSO-1620	1	7	14	D	C.T. #A C.T.#C C.T. #E R062 PB-109 R044 TB-112
0	C079	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSH-1620 SORBENT BIN - 112 HIGH LEVEL SWITCH	1	2	14	D	C.T. #A C.T.#C C.T. #E R036 PB-109 R044 TB-112

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REV	CIRCUIT NO. S	FROM EQUIPMENT/DESC 1/ DESC 2/DEVICE	TO EQUIPMENT/DESC 1/ DESC 2/DEVICE	CABLE DATA				ROUTING
				NO	CN	SIZ	TYP	
0	C080	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSL-1620 SORBENT BIN - 112 LOW LEVEL SWITCH	1	2	14	D	C.T. #A C.T.#C C.T. #E R036 PB-109 R044 TB-112
0	C081	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSLL-1620 SORBENT BIN - 112 LOW -LOW LEVEL ALARM	1	2	14	D	C.T. #A C.T.#C C.T. #E R036 PB-109 R044 TB-112
0	C082	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HV-1621 SORBENT INJECTION AIR VALVE W/ ZSC-1621 FOR VE-112	1	2	14	D	C.T. #A C.T.#C C.T. #E R062 PB-109 R044 TB-112
0	C083	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1510 HOA VOLUMETRIC FEEDER M-FD-101 STATUS INPUT	1	2	14	D	C.T.#A C.T.#B C.T.#D R060 VFCP-101
0	C084	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1520 HOA VOLUMETRIC FEEDER M-FD-102 STATUS INPUT	1	2	14	D	C.T.#A C.T.#B C.T.#D R060 VFCP-101
0	C085	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1530 HOA VOLUMETRIC FEEDER M-FD-103 STATUS INPUT	1	2	14	D	C.T.#A C.T.#B C.T.#D R060 VFCP-101
0	C086	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1540 HOA VOLUMETRIC FEEDER M-FD-104 STATUS INPUT	1	2	14	D	C.T.#A C.T.#B C.T.#D R060 VFCP-101
0	C087	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1550 HOA VOLUMETRIC FEEDER M-FD-105 STATUS INPUT	1	2	14	D	C.T.#A C.T.#B C.T.#D R060 VFCP-101

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				NO	CN	SIZ	TYP	
0	C088	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1560 HOA VOLUMETRIC FEEDER M-FD-106 STATUS INPUT	1	2	14	D	C.T.#A C.T.#B C.T.#D R060 VFCP-101
0	C089	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1570 HOA VOLUMETRIC FEEDER M-FD-107 STATUS INPUT	1	2	14	D	C.T.# A C.T.#C C.T.#E R063 VFCP-102
0	C090	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1580 HOA VOLUMETRIC FEEDER M-FD-108 STATUS INPUT	1	2	14	D	C.T.# A C.T.#C C.T.#E R063 VFCP-102
0	C091	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1590 HOA VOLUMETRIC FEEDER M-FD-109 STATUS INPUT	1	2	14	D	C.T.# A C.T.#C C.T.#E R063 VFCP-102
0	C092	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1600 HOA VOLUMETRIC FEEDER M-FD-110 STATUS INPUT	1	2	14	D	C.T.# A C.T.#C C.T.#E R063 VFCP-102
0	C093	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1610 HOA VOLUMETRIC FEEDER M-FD-111 STATUS INPUT	1	2	14	D	C.T.# A C.T.#C C.T.#E R063 VFCP-102
0	C094	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1620 HOA VOLUMETRIC FEEDER M-FD-112 STATUS INPUT	1	2	14	D	C.T.# A C.T.#C C.T.#E R063 VFCP-102
0	C095	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1630 HOA VOLUMETRIC FEEDER M-FD-113 STATUS INPUT	1	2	14	D	C.T.# A C.T.#C C.T.#E R063 VFCP-102

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				NO	CN	SIZ	TYP	
0	C104	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	FV-1650 HUMIDIFICATION PUMP RECIRCULATING VALVE	1	5	14	D	C.T.#A R095 PB-114
0	C105	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	FV-1652 HUMIDIFICATION SYSTEM LANCE PURGE AIR VALVE	1	2	14	D	C.T.#A R095 PB-114
0	C106	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	FV-1653 HUMIDIFICATION SYSTEM WATER SHUT-OFF VALVE	1	5	14	D	C.T.#A R095 PB-114
0	C107	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	XA-1504 AIR DRYER SYSTEM FAULT ALARM	1	2	14	D	C.T.#A R064 PB-103 R086 PB-108
0	C108	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	PSL-1504 SORBENT FLUIDIZING BLOWER (BL-101) LOW PRESSURE SWITCH	1	2	14	D	C.T.#A C.T.#F R071 PB-101 R069
0	C109	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	PSH-1504 SORBENT FLUIDIZING BLOWER HIGH PRESSURE SWITCH	1	2	14	D	C.T.#A C.T.#F R071 PB-101 R069
0	C110	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	FV-1506 AIR SLIDE BLOWER VENT VALVE	1	7	14	D	C.T. #A R071 PB-101 R072
0	C111	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	FCV-1652 HUMIDIFICATION SYSTEM WATER CONTROL VALVE W/ ZSC-1652	1	2	14	D	C.T.#A R095 PB-114

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				NO	CN	SIZ	TYP	
0	C096	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1640 HOA VOLUMETRIC FEEDER M-FD-114 STATUS INPUT	1	2	14	D	C.T.#A R059 R090
0	C097	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	dPSH-1630 FIL-102 HIGH DIFFERENTIAL PRESSURE SWITCH	1	2	14	D	C.T.#A C.T.#C C.T.#E R036 PB-109 R038 TB-113
0	C098	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	1	7	14	D	INTERFACING CABLE VIA EXISTING FLOOR DUCT (3 OF THE 13 CIRCUITS)
0	C099	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	1	7	14	D	INTERFACING CABLE VIA EXISTING FLOOR DUCT (3 OF THE 13 CIRCUITS)
0	C100	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	1	7	14	D	INTERFACING CABLE VIA EXISTING FLOOR DUCT (3 OF THE 13 CIRCUITS)
0	C101	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1650 HUMIDIFICATION PUMP PMP-101	1	5	14	D	C.T.#A R064 PB-103 R085
0	C102	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	MCC-6 MOTOR CONTROL CENTER HS-1650	1	2	14	D	VIA EXISTING CABLE TRAY
0	C103	MCC-6 MOTOR CONTROL CENTER HS-1650	HS-1650 HUMIDIFICATION PUMP PMP-101	1	2	14	D	C.T.#A R064 PB-103 R085

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				NO	CN	SIZ	TYP	
0	C112	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	FCV-1651 HUMIDIFICATION SYSTEM AIR CONTROL VALVE W/ ZSC-1651	1	5	14	D	C.T.#A R095 PB-114
0	C113	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	PSL-1630 EDUCTOR AIR LOW PRESSURE SWITCH VE-113	1	2	14	D	C.T. #A C.T.#C C.T. #E R062 PB-109 R038 TB-113
0	C114	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSH-1640 SORBENT BIN HOPPER-114 HIGH LEVEL SWITCH	1	2	14	D	C.T.#A R059 TB-114
0	C115	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSL-1640 SORBENT BIN - 114 LOW LEVEL SWITCH	1	2	14	D	C.T.#A R059 TB-114
0	C116	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	EXISTING SQUARE- D PLC CONTROL SYSTEM	1	7	14	D	INTERFACING CABLE VIA EXISTING FLOOR DUCT
0	C117	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	PSL-1640 EDUCTOR AIR LOW PRESSURE SWITCH FOR VE-114	1	2	14	D	C.T.#A R059 TB-114
0	C118	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HV-1641 EDUCTOR AIR SHUT OFF VALVE FOR VE-114 W/ZSC-1641	1	2	14	D	C.T.#A R059 TB-114
0	C119	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	FV-1630 SORBENT BIN -113 CONTROL VALVE W/ZSC & ZSO-1630	1	7	14	D	C.T. #A C.T.#C C.T. #E R062 PB-109 R038 TB-113

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				NO	CN	SIZ	TYP	
0	C120	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSH-1630 SORBENT BIN - 113 HIGH LEVEL SWITCH	1	2	14	D	C.T. #A C.T.#C C.T. #E R062 PB-109 R038 TB-113
0	C121	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	LSL-1630 SORBENT BIN 113 LOW LEVEL SWITCH	1	2	14	D	C.T. #A C.T.#C C.T. #E R036 PB-109 R038 TB-113
0	C122	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LSLL-1630 SORBENT BIN-113 LOW-LOW SWITCH LEVEL	1	2	14	D	C.T. #A C.T.#C C.T. #E R036 PB-109 R038 TB-113
0	C123	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HV-1631 SORBENT INJECTION AIR MANUAL VALVE FOR VE-113 W/ ZSC-1631	1	2	14	D	C.T. #A C.T.#C C.T. #E R062 PB-109 R038 TB-113
0	C124	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	SV-1510 BIN-101 TRANSPORT AIR SOLENOID VALVE	1	2	14	D	C.T.#A C.T.#B C.T.#D R046 PB-110 R048 TB-101
0	C125	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	SV-1520 BIN-102 TRANSPORT AIR SOLENOID VALVE	1	2	14	D	C.T.#A C.T.#B C.T.#D R046 PB-110 R049 TB-102
0	C126	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	SV-1530 BIN-103 TRANSPORT AIR SOLENOID VALVE	1	2	14	D	C.T.#A C.T.#B C.T.#D R046 PB-110 R050 TB-103
0	C127	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	SV-1540 BIN-104 TRANSPORT AIR SOLENOID VALVE	1	2	14	D	C.T.#A C.T.#B C.T.#D R061 PB-110 R051 TB-104

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				NO	CN	SIZ	TYP	
0	C129	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	SV-1550 BIN-105 TRANSPORT AIR SOLENOID VALVE	1	2	14	D	C.T.#A C.T.#B C.T.#D R061 PB-110 R052 TB-105
0	C130	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	SV-1560 BIN-106 TRANSPORT AIR SOLENOID VALVE	1	2	14	D	C.T.#A C.T.#B C.T.#D R061 PB-110 R053 TB-106
0	C131	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	SV-1570 BIN-107 TRANSPORT AIR SOLENOID VALVE	1	2	14	D	C.T.#A C.T.#C C.T.#E R036 PB-109 R039 TB-107
0	C132	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	SV-1580 BIN-108 TRANSPORT AIR SOLENOID VALVE	1	2	14	D	C.T.#A C.T.#C C.T.#E R036 PB-109 R040 TB-108
0	C133	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	SV-1590 BIN-109 TRANSPORT AIR SOLENOID VALVE	1	2	14	D	C.T.#A C.T.#C C.T.#E R036 PB-109 R041 TB-109
0	C134	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	SV-1600 BIN-110 TRANSPORT AIR SOLENOID VALVE	1	2	14	D	C.T.#A C.T.#C C.T.#E R062 PB-109 R042 TB-110
0	C135	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	SV-1610 BIN-111 TRANSPORT AIR SOLENOID VALVE	1	2	14	D	C.T.#A C.T.#C C.T.#E R062 PB-109 R043 TB-111
0	C136	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	SV-1620 BIN-112 TRANSPORT AIR SOLENOID VALVE	1	2	14	D	C.T.#A C.T.#C C.T.#E R062 PB-109 R044 TB-112

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				NO	CN	SIZ	TYP	
0	C137	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	SV-1630 BIN-113 TRANSPORT AIR SOLENOID VALVE	1	2	14	D	C.T.#A C.T.#C C.T.#E R062 PB-109 R038 TB-113
0	C138	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	1	7	14	D	INTERFACING CABLE VIA EXISTING FLOOR DUCT (3 OF THE 13 CIRCUITS)
0	C139	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	1	7	14	D	INTERFACING CABLE VIA EXISTING FLOOR DUCT (3 OF THE 13 CIRCUITS)
0	C140	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	1	7	14	D	INTERFACING CABLE VIA EXISTING FLOOR DUCT (3 OF THE 13 CIRCUITS)
0	C141	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	1	7	14	D	INTERFACING CABLE VIA EXISTING FLOOR DUCT (1 OF THE 13 CIRCUITS)
0	C142	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	1	2	14	D	INTERFACING CABLE VIA EXISTING FLOOR DUCT (1 OF THE 13 CIRCUITS)
0	C143	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (DPS SYS.)	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	1	2	14	D	INTERFACING CABLE VIA EXISTING FLOOR DUCT (3 OF THE 13 CIRCUITS)
0	C144	SORBENT INJECTION MOTOR CONTROL CENTER MCC-6	HS-1641 HAND STATION FOR M-BL-103	1	2	14	D	VIA EXISTING CABLE TRAY C.T.#A R059 TB-114

REV	CIRCUIT NO. S	FROM EQUIPMENT/DESC 1/ DESC 2/DEVICE	TO EQUIPMENT/DESC 1/ DESC 2/DEVICE	CABLE DATA				ROUTING
				NO	CN	SIZ	TYP	
0	C145	LVDP-106 BRK. # SP 15 AMP 120-240 VOLT 1 PH POWER PANEL	HS-1642 120 V0LT POWER FOR SOLENOID VALVE FOR FV-1642	1	3	14	D	R009 PB-102 R055 TB-114
0	C146	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	dPSH-1504 SORBENT SILO VENT FILTER DIFFERENTIAL PRESSURE SWITCH	1	2	14	D	R065 TB-116 R066 PB-1-1 R011 C.T. #A
0	C147	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1631 HOA SWITCH @ FIL-102 FOR M-BL-102	1	5	14	D	VIA EXISTING CABLE TRAY C.T.#A C.T.#C C.T.#E R110
0	C148	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	MCC-6 MOTOR CONTROL CENTER HS-1631	1	2	14	D	VIA EXISTING CABLE TRAY
0	C149	MCC-6 MOTOR CONTROL CENTER HS-1631	HS-1631 HOA SWITCH @ FIL-102 FOR M-BL-102	1	2	14	D	VIA EXISTING CABLE TRAY C.T.#A C.T.#C C.T.#E R110
0	C150	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)						
			E- INSTRUMENTATION CIRCUITS					
0	E001	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	LIT-1501 SORBENT SILO LEVEL TRANSMITTER	1	1 PR TW SHLD	16	E	C.T. #A R011 PB-101 R066 TB-116 R005

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				NO	CN	SIZ	TYP					
0	E002	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	TT-1501 SORBENT TRANSFER AIR TEMPERATURE TRANSMITTER	1	1 PR TW SHLD	16	E	C.T.#A	C.T.#F	R071	PB-101	R099
0	E003	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	PT-1501 SORBENT TRANSFER AIR PRESSURE TRANSMITTER	1	1 PR TW SHLD	16	E	C.T.#A	C.T.#F	R071	PB-101	R099
0	E004	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	PT-1502 SORBENT INJECTION AIR PRESSURE TRANSMITTER	1	1 PR TW SHLD	16	E	C.T.#A	R064	PB-103	R086	PB-108
0	E005	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	TT-1502 SORBENT INJECTION AIR TEMPERATURE TRANSMITTER	1	1 PR TW SHLD	16	E	C.T.#A	R064	PB-103	R086	PB-108
0	E006	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	FT-1502 SORBENT INJECTIOON AIR FLOW TRANSMITTER	1	1 PR TW SHLD	16	E	C.T.#A	R064	PB-103	R086	PB-108
0	E007	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1510 SORBENT BIN -101 VOLUMETRIC FEEDER SPEED CONTROL & FEEDBACK	1	2 PR TW SHLD	16	E	C.T.#A	C.T.#B	C.T.#D 101	R060	VFCP-
0	E008	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1520 SORBENT BIN- 102 VOLUMETRIC FEEDER SPEED CONTROL & FEEDBACK	1	2 PR TW SHLD	16	E	C.T.#A	C.T.#B	C.T.#D 101	R060	VFCP-

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				NO	CN	SIZ	TYP	
0	E009	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1530 SORBENT BIN-103 VOLUMETRIC FEEDER SPEED CONTROL & FEEDBACK	1	2 PR TW SHLD	16	E	C.T.#A C.T.#B C.T.#D 101 R060 VFCP-
0	E010	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1540 SORBENT BIN-104 VOLUMETRIC FEEDER SPEED CONTROL & FEEDBACK	1	2 PR TW SHLD	16	E	C.T.#A C.T.#B C.T.#D 101 R060 VFCP-
0	E011	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1550 SORBENT BIN-105 VOLUMETRIC FEEDER SPEED CONTROL & FEEDBACK	1	2 PR TW SHLD	16	E	C.T.#A C.T.#B C.T.#D 101 R060 VFCP-
0	E012	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1560 SORBENT BIN-106 VOLUMETRIC FEEDER SPEED CONTROL & FEEDBACK	1	2 PR TW SHLD	16	E	C.T.#A C.T.#B C.T.#D 101 R060 VFCP-
0	E013	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1570 SORBENT BIN -107 VOLUMETRIC FEEDER SPEED CONTROL & FEEDBACK	1	2 PR TW SHLD	16	E	C.T.# A C.T.#C C.T.#E R063 VFCP-102
0	E014	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1580 SORBENT BIN-108 VOLUMETRIC FEEDER SPEED CONTROL & FEEDBACK	1	2 PR TW SHLD	16	E	C.T.# A C.T.#C C.T.#E R063 VFCP-102

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REV	CIRCUIT NO. S	FROM EQUIPMENT/DESC 1/ DESC 2/DEVICE	TO EQUIPMENT/DESC 1/ DESC 2/DEVICE	CABLE DATA				ROUTING
				NO	CN	SIZ	TYP	
0	E015	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1590 SORBENT BIN-109 VOLUMETRIC FEEDER SPEED CONTROL & FEEDBACK	1	2 PR TW SHLD	16	E	C.T.# A C.T.#C C.T.#E R063 VFCP-102
0	E016	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1600 SORBENT BIN-110 VOLUMETRIC FEEDER SPEED CONTROL & FEEDBACK	1	2 PR TW SHLD	16	E	C.T.# A C.T.#C C.T.#E R063 VFCP-102
0	E017	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1610 SORBENT BIN-111 VOLUMETRIC FEEDER SPEED CONTROL & FEEDBACK	1	2 PR TW SHLD	16	E	C.T.# A C.T.#C C.T.#E R063 VFCP-102
0	E018	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1620 SORBENT BIN-112 VOLUMETRIC FEEDER SPEED CONTROL & FEEDBACK	1	2 PR TW SHLD	16	E	C.T.# A C.T.#C C.T.#E R063 VFCP-102
0	E019	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1630 SORBENT BIN -113 VOLUMETRIC SCREW FEEDER SPEED CONTROL & FEEDBACK	1	2 PR TW SHLD	16	E	C.T.# A C.T.#C C.T.#E R063 VFCP-102
0	E020	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	HS-1640 SORBENT BIN -114 VOLUMETRIC SCREW FEEDER SPEED CONTROL & FEEDBACK	1	2 PR TW SHLD	16	E	C.T.#A C.T.#C C.T.#E R059 VFCP-103
0	E021	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	TE-1650A HUMIDIFICATION DUCT THERMOCOUPLE -A	1	1 PR	16	JX	C.T.#A R095 PB-114 R096 R097

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REV	CIRCUIT NO. S	FROM EQUIPMENT/DESC 1/ DESC 2/DEVICE	TO EQUIPMENT/DESC 1/ DESC 2/DEVICE	CABLE DATA				ROUTING
				NO	CN	SIZ	TYP	
0	E022	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	EXISTING SQUARE-D PLC CONTROL PANEL CP-1	1	2 PR TW SHLD	16	E	VIA EXISTING FLOOR DUCT INTERFACING CABLES FOR NEW PLC RACK
0	E023	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	TE-1650B HUMIDIFICATION DUCT THERMOCOUPLE -B	1	1 PR	16	JX	C.T.#A R095 PB-114 R096 R097
0	E024	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	TE-1650C HUMIDIFICATION DUCT THERMOCOUPLE -C	1	1 PR	16	JX	C.T.#A R095 PB-114 R096 R097
0	E025	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	TE-1650D HUMIDIFICATION DUCT THERMOCOUPLE -D	1	1 PR	16	JX	C.T.#A R095 PB-114 R096 R097
0	E026	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	EXISTING SQUARE-D PLC CONTROL PANEL CP-1	1	2 PR TW SHLD	16	E	VIA EXISTING FLOOR DUCT INTERFACING CABLES FOR NEW PLC RACK
0	E027	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	FT-1650 HUMIDIFICATION WATER FLOW INTERGAL FLOW TRANSMITTER	1	1 PR TW SHLD	16	E	C.T.#A R095 PB-114
0	E028	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	PT-1651 HUMIDIFICATION SYSTEM AIR PRESSURE TRANSMITTER	1	1 PR TW SHLD	16	E	C.T.#A R095 PB-114
0	E029	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	FCV-1651 HUMIDIFICATION SYSTEM AIR FLOW CONTROL VALVE	1	1 PR TW SHLD	16	E	C.T.#A R095 PB-114

REV	CIRCUIT NO. S	FROM EQUIPMENT/DESC 1/ DESC 2/DEVICE	TO EQUIPMENT/DESC 1/ DESC 2/DEVICE	CABLE DATA				ROUTING
				NO	CN	SIZ	TYP	
0	E030	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	PT-1652 HUMIDIFICATION SYSTEM WATER PRESSURE TRANSMITTER	1	1 PR TW SHLD	16	E	C.T.#A R095 PB-114
0	E031	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	FT-1651 HUMIDIFICATION AIR FLOW TRANSMITTER	1	1 PR TW SHLD	16	E	C.T.#A R095 PB-114
0	E032	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)	FCV-1652 HUMIDIFICATION SYSTEM WATER CONTROL VALVE	1	1 PR TW SHLD	16	E	C.T.#A R095 PB-114
0	E033	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)						
0	E034	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)						
0	E035	NEW DPS & SQ-D MAIN PLC CONTROL PANEL CP-2 (SQ-D SYS.)						
			P- POWER CIRCUITS					
0	P001	EXISTING 480 VOLT FGR	SORBENT INJECTION	1 1	6-1/C 1/C	350 350 MCM	B GND	VIA EXISTING 480 VOLT POWER DUCT

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REV	CIRCUIT NO. S	FROM EQUIPMENT/DESC 1/ DESC 2/DEVICE	TO EQUIPMENT/DESC 1/ DESC 2/DEVICE	CABLE DATA NO	CN	SIZ	TYP	ROUTING
0	P002	SORBENT INJECTION MOTOR CONTROL CENTER MCC-6	NEW POWER SOURCE FOR FGR FAN USING EXISTING CABLES					RE-ROUTE EXISTING POWER CABLES TO MCC-6 200 AMP BREAKER
0	P003	LVDP-107 BRK #2 120-240 VOLT POWER PANEL(SILO)	HTR-101 SILO STEAM HEATER FAN MOTOR	1	3/C	12	C	R068
0	P004	SORBENT INJECTION MOTOR CONTROL CENTER MCC-6	M- BL-102 EXCHAUST FAN FIL-102 @ BN-113	1	4/C	10	C	EXISTING 480 VOLT PULL BOX #A R081 R083
0	P005	SORBENT INJECTION MOTOR CONTROL CENTER MCC-106	PMP-101 HUMIDIFICATION WATER PUMP FOR M-PMP-101	1	4/C	10	C	EXISTING 480 VOLT PULL BOX #A R077
0	P006	SORBENT INJECTION MOTOR CONTROL CENTER MCC-106	BL-101 SORBENT FLUIDIZING BLOWER FOR M-BL-101	1	4/C	10	C	EXISTING 480 VOLT PULL BOX #A R078
0	P007	SORBENT INJECTION MOTOR CONTROL CENTER MCC-6	TLVD-106 PRIMARY 480 VOLT / 120-240 VOLT 1PH 50 KVA TRANSFORMER	1 1	2 1/C	2 2	B GND	R079
0	P008	XFMR-101 120-240 VOLT SEC 1PH 50 KVA TRANSFORMER	LVDP-106 120-240 VOLT BRK# MB 1PH 200 AMP PWR PANEL	1 1	3-1/C 1/C	3/0 1/0	B GND	R080

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REV	CIRCUIT NO. S	FROM EQUIPMENT/DESC 1/ DESC 2/DEVICE	TO EQUIPMENT/DESC 1/ DESC 2/DEVICE	CABLE DATA				ROUTING
				NO	CN	SIZ	TYP	
0	P009	LVDP-108 BRK # 1&3 120-240 VOLT 1PH PWR PANEL (ELEV1077'-0")	VFCP-101 VOLUMETRIC CONTROL PANEL FOR M-FD-101 THRU M-FD-106	1	4/C	10	C	R018
0	P010	LVDP-108 BRK #2&4 120-240 VOLT 1PH PWR PANEL (ELEV1077'-0")	VFCP-102 VOLUMETRIC CONTROL PANEL FOR M-FD-107 THRU M-FD-113	1	4/C	10	C	R017
0	P011	SORBENT INJECTION MOTOR CONTROL CENTER MCC-106	BL-103 BAG BREAK STATION EXCHAUST FAN M-BL-103	1	4/C	10	C	EXISTING 480 VOLT PULL BOX #A R081 R082
0	P012	LVDP-106 BRK # 1&3 120-240 VOLT 1PH PWR PANEL(EQUIP RM)	LVDP-107 BRK. #MB 120-240 V0LT 1PH POWER PANEL (SILO)	1	4/C	10	C	R008 PB-102 R010
0	P013	LVDP-106 BRK # 9 120-240 VOLT 1PH PWR PANEL(EQUIP RM)	AD-101 INSTRUMENT AIR DRYER	1	3/C	12	C	R008 PB-102 R013
0	P014	LVDP-107 BRK. #3 120-240 V0LT 1PH POWER PANEL (SILO)	LIT-1501 SORBENT SILO LEVEL TRANSMITTER	1	3/C	12	C	R067 PB-101 R066 TB-116 R005
0	P015	LVDP-107 BRK. # 1 120-240 V0LT 1PH POWER PANEL (SILO)	XC-1501 & SV-1501 SORBENT SILO FILTER PLUSING TIMER	1	3/C	12	C	R014
0	P016	LVDP-106 BRK #2&4 120-240 VOLT 1PH PWR PANEL(EQUIP RM)	LVDP-108 LOCATED @ELEVATION 1077'-2" SOUTH WALL	3 1	1/C 1/C	4 4	B GND	R009 PB-102 R016

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REV	CIRCUIT NO. S	FROM EQUIPMENT/DESC 1/ DESC 2/DEVICE	TO EQUIPMENT/DESC 1/ DESC 2/DEVICE	CABLE DATA NO	CN	SIZ	TYP	ROUTING
0	P017	LVDP-107 BRK. #4 120-240 V0LT 1PH POWER PANEL (SILO)	LSH & LSL-1502 TRANSPORTER LEVEL SWITCHES TB-115	1	3/C	14	C	R067 PB-101 R007 TB-115
0	P018	EXISTING MOTOR CONTROL CENTER MCC-4 NEW 200 AMP BRK.	125 HP SULLAIR INSTRUMENT AIR COMPRESSOR CMP-103	3 1	1/C 1/C	3/0 2	B GND	EXISTING 480 VOLT PULL BOX #A R076
0	P019	VFCP-102 VOLUMETRIC FEEDER CONTROL PANEL (ELEV 1077'-0")	BN-113 VOLUMETRIC FEEDER MOTOR M-FD-113	1	3/C	12	C	R019
0	P020	VFCP-102 VOLUMETRIC FEEDER CONTROL PANEL (ELEV 1077'-0")	BN-107 VOLUMETRIC FEEDER MOTOR M-FD-107	1	3/C	12	C	R020 PB-104 R021
0	P021	VFCP-102 VOLUMETRIC FEEDER CONTROL PANEL (ELEV 1077'-0")	BN-108 VOLUMETRIC FEEDER MOTOR M-FD-108	1	3/C	12	C	R020 PB-104 R022
0	P022	VFCP-102 VOLUMETRIC FEEDER CONTROL PANEL (ELEV 1077'-0")	BN-109 VOLUMETRIC FEEDER MOTOR M-FD-109	1	3/C	12	C	R020 PB-104 R023
0	P023	VFCP-102 VOLUMETRIC FEEDER CONTROL PANEL (ELEV 1077'-0")	BN-110 VOLUMETRIC FEEDER MOTOR M-FD-110	1	3/C	12	C	R024 PB-105 R025
0	P024	VFCP-102 VOLUMETRIC FEEDER CONTROL PANEL (ELEV 1077'-0")	BN-111 VOLUMETRIC FEEDER MOTOR M-FD-111	1	3/C	12	C	R024 PB-105 R026

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				NO	CN	SIZ	TYP	
0	P025	VFCP-102 VOLUMETRIC FEEDER CONTROL PANEL (ELEV 1077'-0")	BN-112 VOLUMETRIC FEEDER MOTOR M-FD-112	1	3/C	12	C	R024 PB-105 R027
0	P026	VFCP-101 VOLUMETRIC FEEDER CONTROL PANEL (ELEV 1077'-0")	BN-106 VOLUMETRIC FEEDER MOTOR M-FD-106	1	3/C	12	C	R028 PB-106 R029
0	P027	VFCP-101 VOLUMETRIC FEEDER CONTROL PANEL (ELEV 1077'-0")	BN-105 VOLUMETRIC FEEDER MOTOR M-FD-105	1	3/C	12	C	R028 PB-106 R030
0	P028	VFCP-101 VOLUMETRIC FEEDER CONTROL PANEL (ELEV 1077'-0")	BN-104 VOLUMETRIC FEEDER MOTOR M-FD-104	1	3/C	12	C	R028 PB-106 R031
0	P029	VFCP-101 VOLUMETRIC FEEDER CONTROL PANEL (ELEV 1077'-0")	BN-103 VOLUMETRIC FEEDER MOTOR M-FD-103	1	3/C	12	C	R032 PB-107 R033
0	P030	VFCP-101 VOLUMETRIC FEEDER CONTROL PANEL (ELEV 1077'-0")	BN-102 VOLUMETRIC FEEDER MOTOR M-FD-102	1	3/C	12	C	R032 PB-107 R034
0	P031	VFCP-101 VOLUMETRIC FEEDER CONTROL PANEL (ELEV 1077'-0")	BN-101 VOLUMETRIC FEEDER MOTOR M-FD-101	1	3/C	12	C	R032 PB-107 R035
0	P032	LVDP-108 BRK #17 120-240 VOLT 1PH PWR PANEL (ELEV 1077'-0")	BN -113 LEVEL SWITCHES LSL/LSH-1630 TB-113	1	3/C	14	C	R037 PB-109 R038 TB-113

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REV	CIRCUIT NO. S	FROM EQUIPMENT/DESC 1/ DESC 2/DEVICE	TO EQUIPMENT/DESC 1/ DESC 2/DEVICE	CABLE DATA				ROUTING
				NO	CN	SIZ	TYP	
0	P033	LVDP-108 BRK # 5 120-240 VOLT 1PH PWR PANEL (ELEV 1077'-0")	BN -107 LEVEL SWITCHES LSL/LSH-1570 TB-107	1	3/C	14	C	R037 PB-109 R039 TB-107
0	P034	LVDP-108 BRK # 7 120-240 VOLT 1PH PWR PANEL (ELEV 1077'-0")	BN -108 LEVEL SWITCHES LSL/LSH-1580 TB-108	1	3/C	14	C	R037 PB-109 R040 TB-108
0	P035	LVDP-108 BRK #9 120-240 VOLT 1PH PWR PANEL (ELEV 1077'-0")	BN -109 LEVEL SWITCHES LSL/LSH-1590 TB-109	1	3/C	14	C	R037 PB-109 R041 TB-109
0	P036	LVDP-108 BRK #11 120-240 VOLT 1PH PWR PANEL (ELEV 1077'-0")	BN -110 LEVEL SWITCHES LSL/LSH-1600 TB-110	1	3/C	14	C	R037 PB-109 R042 TB-110
0	P037	LVDP-108 BRK #13 120-240 VOLT 1PH PWR PANEL (ELEV 1077'-0")	BN -111 LEVEL SWITCHES LSL/LSH-1610 TB-111	1	3/C	14	C	R037 PB-109 R043 TB-111
0	P038	LVDP-108 BRK #15 120-240 VOLT 1PH PWR PANEL (ELEV 1077'-0")	BN -112 LEVEL SWITCHES LSL/LSH-1620 TB-112	1	3/C	14	C	R037 PB-109 R044 TB-112
0	P039	LVDP-108 BRK #16 120-240 VOLT 1PH PWR PANEL (ELEV 1077'-0")	BN -101 LEVEL SWITCHES LSL/LSH-1510 TB-101	1	3/C	14	C	R047 PB-110 R048 TB-101
0	P040	LVDP-108 BRK #14 120-240 VOLT 1PH PWR PANEL (ELEV 1077'-0")	BN -102 LEVEL SWITCHES LSL/LSH-1520 TB-102	1	3/C	14	C	R047 PB-110 R049 TB-102

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REV	CIRCUIT NO. S	FROM EQUIPMENT/DESC 1/ DESC 2/DEVICE	TO EQUIPMENT/DESC 1/ DESC 2/DEVICE	CABLE DATA				ROUTING
				NO	CN	SIZ	TYP	
0	P041	LVDP-108 BRK #12 120-240 VOLT 1PH PWR PANEL (ELEV 1077'-0")	BN -103 LEVEL SWITCHES LSL/LSH-1530 TB-103	1	3/C	14	C	R047 PB-110 R050 TB-103
0	P042	LVDP-108 BRK #10 120-240 VOLT 1PH PWR PANEL (ELEV 1077'-0")	BN -104 LEVEL SWITCHES LSL/LSH-1540 TB-104	1	3/C	14	C	R047 PB-110 R051 TB-104
0	P043	LVDP-108 BRK #8 120-240 VOLT 1PH PWR PANEL (ELEV 1077'-0")	BN -105 LEVEL SWITCHES LSL/LSH-1550 TB-105	1	3/C	14	C	R047 PB-110 R052 TB-105
0	P044	LVDP-108 BRK. #6 120-240 VOLT 1PH POWER PANEL (SILO)	BN -106 LEVEL SWITCHES LSL/LSH-1560 TB-106	1	3/C	14	C	R047 PB-110 R053 TB-106
0	P045	VFCP-103 VOLUMETRIC FEEDER CONTROL PANEL FOR BBS-114	BN-114 BAG BREAK STATION MOTOR M-FD-114	1	3/C	12	C	R054
0	P046	LVDP-106 BRK # 5&7 120-240 VOLT 1PH PWR PANEL(EQUIP RM)	VFCP-103 VOLUMETRIC CONTROL PANEL FOR BBS-114	1	4/C	10	C	R009 PB-102 R055
0	P047	LVDP-106 BRK. #12 120-240 VOLT 1PH POWER PANEL(EQUIP RM)	HUMIDIFICATION HEAT TRACING 5 WATT/FT @ ELEVATION 1036 0" 5	1	3/C	12	C	R098 R100
0	P048	LVDP-106 BRK. #14 120-240 VOLT 1PH POWER PANEL(EQUIP RM)	HUMIDIFICATION HEAT TRACING 5 WATT/FT @ ELEVATION 1036 0" 5	1	3/C	12	C	R098 R101

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REV	CIRCUIT NO. S	FROM EQUIPMENT/DESC 1/ DESC 2/DEVICE	TO EQUIPMENT/DESC 1/ DESC 2/DEVICE	CABLE DATA				ROUTING
				NO	CN	SIZ	TYP	
0	P049	EXISTING 277 VOLT LIGHTING PANEL HV-2	HUMIDIFICATION DUCT PLATFORM LIGHTING @ 1036' 0" ELEVATION	1	3/C	12	C	R102
0	P050	EXISTING 277 VOLT LIGHTING PANEL HV-2	277 VOLT SILO AREA OUTSIDE LIGHTING 5-HPS FIXTURES/CIRCUIT	1	3/C	12	C	HV-2 R074 PB-115 R102 PB-116 R103
0	P051	LVDP-107 BRK. #6 120-240 VOLT 1PH POWER PANEL (SILO)	LSLL-1501 SORBENT SILO LOW-LOW LEVEL SWITCH	1	3/C	14	C	R004 PB-1-1 R067
0	P052	EXISTING 277 VOLT LIGHTING PANEL HV-2	277 VOLT SILO SKIRT LIGHTING 3 HPS FIXTURES/ CIRCUIT	1	3/C	12	C	HV-2 R074 PB-115 R102 PB-116 R104
0	P053	LVDP-107 BRK. # 8 120-240 VOLT 1PH POWER PANEL (SILO)	120 VOLT 20 AMP GFI RECEPTACLES 2 PER/CKT (SILO)	1	3/C	12	C	P052
0	P054	LVDP-107 BRK. # 5 120-240 VOLT 1PH POWER PANEL (SILO)	LSH/LAH-1501 SORBENT SILO HGH LEVEL SWITCH AND ALARM	1	3/C	14	C	R067 PB-101 R066 TB-116 R058
0	P055	277 V0LT SORBENT SILO LIGHTING FIXTURES (INSIDE)	277 VOLT (S1) SWITCH @ SORBENT SILO	1	3/C	14	C	R105
0	P056	277 VOLT PHOT CELL @ SORBENT SILO AREA	277 VOLT LIGHTING CONTACTOR @ SORBENT SILO (INSIDE)	1	3/C	14	C	PB-115 R104 PB-116 R108

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REV	CIRCUIT NO. S	FROM EQUIPMENT/DESC 1/ DESC 2/DEVICE	TO EQUIPMENT/DESC 1/ DESC 2/DEVICE	CABLE DATA				ROUTING
				NO	CN	SIZ	TYP	
0	P057	277 VOLT LIGHTING CONTACTOR @ SORBENT SILO (INSIDE)	(5) 100 W HPS SORBENT SILO FIXTURES @ TOP OF SILO AND PLATFORM	1	3/C	12	C	R108 PB-116 R109
0	P058	277 VOLT LIGHTING CONTACTOR @ SORBENT SILO (INSIDE)	(1) 100 W HPS FIXTURES MOUNTED ON SIDE OF BUILDING	1	3/C	12	C	R108 PB-116 R104 PB-115
0	P059	LVDP-106 BRK. #8 120-240 VOLT 1PH POWER PANEL (EQUIP. RM.)	BN -114 LEVEL SWITCHES LSL/LSH-1640 TB-114 @ BAG BREAK STATION	1	3\C	14	C	R009 PB-102 R055 R057 TB-114
0	P060	LVDP-106 BRK. #6 120-240 VOLT 1PH POWER PANEL (EQUIP. RM.)	HS-1642 120 VOLT POWER FOR SOLENOID VALVE FOR FV-1642	1	3	14	D	R009 PB-102 R055 R057 TB-114

APPENDIX J. OWEF Letter of Commitment

COUNTY OF Olmsted

PUBLIC WORKS DEPARTMENT
2122 CAMPUS DR SE
ROCHESTER MN 55904-4744
507/285-8231

9-8-92

Institute Of Gas Technology
Energy Development Center
4201 W. 36th St.
Chicago, IL 60632-3898

Attn: Stan Wohadlo
Subject: Emission Reduction Test System (ERTS) - Restoration

Dear Stan,

I would like to take this opportunity to express our satisfaction with, and commitment to, the continued cooperation between our two organizations in the advancement of the ERTS project now in development. The work being performed by the IGT staff is exceptional and we take pleasure in noting this fact.

Olmsted County remains committed to hosting the project at the Olmsted Waste-to-Energy Facility. Further, the County hereby reaffirms it's support of the project by agreeing to take responsibility for any costs for restoration work which may be necessary following the completion of the testing phase of the ERTS project.

We share IGT's confidence in the ability of the system to achieve it's objectives and look forward to a successful project completion.

Sincerely,

Rob Dunnette
Plant Manager
Olmsted Waste-to-Energy Facility

copy: Michael T. Cousino
Gene Mossing

APPENDIX K. ERTS Major Equipment Cost and Preferred Vendor List

MAJOR EQUIPMENT PREFERRED VENDOR LIST
IGT - OWEF

TAG #	VENDORS	QUOTED PRICE	PREF. VENDOR	COMMENTS
AS-101 A/B/C/D/E/F	FULLER CO UCC	$2,773.00 $23,425.00	FULLER CO.	 WITH BLOWER
AD-100	SULLAIR (BY DIVERSIFIED AIR)	$3,485.00	SULLAIR	SOLE SOURCE
ATV-101	DYNAMIC AIR NOL-TEC WHIRL-AIR FLOW	$36,122.00 $66,450.00 $63,790.00	DYNAMIC AIR	SYSTEM SYSTEM SYSTEM
BL-101	ROOTS ROTRON (BY FLUIDRUALICS) UCC -PD BLOWER	$6,100.00 $3,535.00 WITH AIR SLIDES	ROTRON	
CM-103	SULLAIR (BY DIVERSIFIED AIR)	$22,995.00	SULLAIR	SOLE SOURCE
FD-101 THRU FD-112	ACCURATE VIBRASCREW ACRISON METAL-FAB	$55,140.00 $68,152.00 $127,084.00 $52,944.00	ACRISON	
FD-113	ACCURATE VIBRASCREW ACRISON METAL-FAB	$4,595.00 $5,752.00 WITH #1-12 $5,013.00	ACRISON	
FD-114	ACCURATE VIBRASCREW ACRISON METAL-FAB	$4,595.00 $5,752.00 $5,297.00 $4,313.00	ACRISON	
FIL-101	DYNAMIC AIR NOL-TEC WHIRL-AIR FLOW	$2,987.00 $3,560.00 $4,895.00	DYNAMIC AIR	
FIL-102	DYNAMIC AIR NOL-TEC	$1,854.00 $4,230.00	DYNAMIC AIR	

MAJOR EQUIPMENT PREFERRED VENDOR LIST IGT - OWEF				
TAG #	VENDORS	QUOTED PRICE	PREF. VENDOR	COMMENTS
AR-101	McMASTER CARR GRANGER TOMLIN EQUIP.	$395.74 $478.27 $460.00	McMASTER CARR	
BBS-114	DYNAMIC AIR DUST CNRL LOADING PREMIER PNEUM.	$3,530.00 $8,897.00 $7,549.00	DYNAMIC AIR	
HTR-101	WING HEATERS	$1,334.00	WING HEATER	SOLE SOURCE
SEP-101	SUMMIT OIL	$1,610.00	SUMMIT OIL	SOLE SOURCE WITH SULLAIR
PMP-101	ALLEN PUMP CO. GOULD PUMP (BY ESTABROOK) GELBER IND.	$2,494.00 $1,980.00 $1,555.00	GOULD	
SIL-101	PEABODY TECH NOL-TEC WHIRL-AIR FLOW DYNAMIC AIR	$21,040.00 $32,567.00 $33,084.00 $19,980.00	PEABODY	
VE-101 THRU VE-112	FOX	$300.00	FOX	
VE-113	FOX	$350.00	FOX	
VE-114	FOX	$300.00	FOX	

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APPENDIX L. RFQ Specification Manual – Table of Contents

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Section 2E - NOT USED

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APPENDIX M. Questimate Report Summary

APPENDIX M. Questimate Report Summary

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*   EMISSIONS REDUCTION TESTING SYSTEM FOR OLMSTED WTE FACILITY      *
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**********************************************************************
*                                                                    *
*                                                                    *
*                                    Report Date:  23 SEP 1992       *
*                                    Prepared by:      TAM           *
*                                    Database Name:     ERTS         *
*                                                                    *
*                                                                    *
*  ------------------------------------------------------------      *
*                        R E P O R T S                               *
*  ------------------------------------------------------------      *
*                                                                    *
*     1 - SUMMARY OF PROJECT COSTS                                   *
*                                                                    *
*     2 - SUMMARY OF DIRECT COSTS - BY CODE OF ACCOUNT               *
*                                                                    *
*     3 - PROCESS EQUIPMENT AND INSTALLATION COSTS                   *
*                                                                    *
*     4 - DETAILS OF ITEM INSTALLATION (80 char)                     *
*                                                                    *
*     5 - LIST OF PROJECT COMPONENTS                                 *
*                                                                    *
*  ------------------------------------------------------------      *
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*                          ICARUS QUESTIMATE Plant Cost System       *
*                          Version 6.1A          November 1991       *
*                                                                    *
*                                                                    *
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SUMMARY OF PROJECT COSTS

PROJECT COST ESTIMATE JOB NO: 8731 CLASS: ST

PROJECT: EMISSIONS REDUCTION TESTING SYSTEM FOR OLMSTED WTE FACILITY

LOCATION: ROCHESTER, MINN PROJECT DATABASE: ERT

DATE PREPARED: 23 SEP 1992 PREPARED BY: TAM

NO.	DIRECT FIELD COSTS	DIRECT FIELD HOURS	THOUSANDS OF DOLLARS MATERIAL	LABOR	TOTAL
1	EQUIPMENT	1690	248.7	65.9	314.
2	PIPING	1402	12.9	54.7	67.
3	CIVIL,SITEWORK	190	3.5	6.1	9.
4	STEELWORK	0	0.0	0.0	0.
5	INSTRUMENTATION	960	79.2	37.4	116.
6	ELECTRICAL	3194	66.4	124.6	191.
7	INSULATION	0	0.0	0.0	0.
8	PAINTING	85	0.8	2.7	3.
9	TOTAL DIRECT COSTS	7521	411.5	291.4	702.
	CONSTRUCTION INDIRECT COSTS:				
10	MISC. (INSURANCE,ETC)				14.
11	SPECIAL INDIRECT ITEM 1				58.
12	SPECIAL INDIRECT ITEM 2				14.
13	FIELD SUPERVISION				58.
14	CONSTRUCTION OHD & FEE				212.
	OTHER PROJECT COSTS:				
15	FREIGHT				28.
16	TAXES, PERMITS				24.
17	ENGINEERING				42.
18	SUBTOTAL				1156.
19	CONTINGENCY				231.
20	TOTAL PROJECT COST				1387.

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4. Title and Subtitle

Field Evaluation of Natural Gas and Dry Sorbent Injection for MWC Emissions Control

5. Publication Date
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6.

7. Author(s)
S. Wohadlo, H. Abbasi, D. Cygan

8. Performing Organization Rept. No.
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National Renewable Energy Laboratory
1617 Cole Blvd.
Golden, Colorado 80401-3393

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(G)

12. Sponsoring Organization Name and Address
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Golden, CO 80401-3393

13. Type of Report & Period Covered
Subcontract report

14.

15. Supplementary Notes
NREL technical monitor: Philip Shepherd, (303)231-7000, ext.7829

16. Abstract (Limit: 200 words)

The Institute of Gas Technology (IGT), in cooperation with the Olmsted Waste-to-Energy Facility (OWEF) and with subcontracted engineering services from the Energy and Environmental Research Corporation (EER), has completed the detailed engineering and preparation of construction specifications for an Emissions Reduction Testing System (ERTS).

The ERTS has been designed for retrofit to one of two 100-ton/day municipal waste combustors at the OWEF, located in Rochester, Minnesota. The purpose of the retrofit is to conduct a field evaluation of a combined natural gas and sorbent injection process (IGT's METHANE de-TOX^{SM}, IGT Patent No. 5,105,747) for reducing the emissions of oxides of nitrogen (NO_x), hydrochloric acid (HCl), oxides of sulfur (SO_x), carbon monoxide (CO), total hydrocarbons (THC), and chlorinated hydrocarbons (dioxins/furans). In addition, the design includes modifications for the control of heavy metals (HM). Development of the process should allow the waste-to-energy industry to meet the Federal New Source Performance Standards for these pollutants at significantly lower costs when compared to existing technology of Thermal deNO_x combined with spray dryer scrubber/fabric filters. Additionally, the process should reduce boiler corrosion and increase both the thermal and power production efficiency of the facility.

17. Document Analysis
a. Descriptors
municipal waste; waste to energy; emissions

b. Identifiers/Open-Ended Terms

c. UC Categories
249

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