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Engineering Report, Standard Hydrogen Monitoring System Problems

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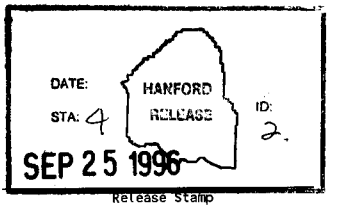

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ENGINEERING REPORT
STANDARD HYDROGEN MONITORING SYSTEM PROBLEMS

Prepared for

WESTINGHOUSE HANFORD COMPANY
Purchase Order MSJ-SBW-336070
Report No. 961140-002
Revision 0

September 1996

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Date: 9-16-96

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APPENDICES

ABBREVIATIONS

cm	Centimeter
ft	Foot
m	Meter
PPMV	Parts Per Million Volume
SCFM	Standard Cubic Feet per Minute

ACRONYMS

DSC	Differential Scanning Calorimetry
DST	Double-Shell Tank
ECN	Engineering Change Notice
HEPA	High-Efficiency Particulate Air
ICP	Inductively Coupled Plasma
MSDS	Material Safety Data Sheet
SDD	System Design Descriptions
SHMS	Standard Hydrogen Monitor System
SST	Single-Shell Tank
TMACS	Tank Monitoring and Control System
TOC	Total Organic Carbon
WHC	Westinghouse Hanford Company

TRADEMARKS

Anchorlube G-771™ is a registered trademark of Anchor Chemical Company, Westlake, Ohio
SmartView™ is a registered trademark of Westronics, Inc., Humble, Texas

1.0 INTRODUCTION

1.1 Background and Problem Description

The Standard Hydrogen Monitor System (SHMS) is a system designed to monitor the vapor space gases within underground radioactive waste storage tanks at the Hanford Site. Originally designed to measure hydrogen concentration, additional variations have since been designed that are capable of monitoring other gases (e.g., ammonia). The primary purpose of the SHMS is to determine whether hydrogen is being periodically released in flammable concentrations within the tanks, or whether the hydrogen is released continually at a low level. This requires continuous monitoring of the tank dome space for hydrogen concentrations over a relatively long period (in some cases, several years). A detailed description of the system and purpose are contained in the System Design Descriptions (SDDs) for the different variations. For this report, only the SHMS-B was considered, which is described in WHC-SD-WM-SDD-055, *Standard -B Hydrogen Monitoring System, System Design Description* (WHC 1994).

As of March 30, 1995, SHMS were installed on 23 Flammable Gas Watch List Tanks. These included 4 double-shell tanks (DSTs) and 19 single-shell tanks (SSTs). The DSTs are actively ventilated tanks, while the SSTs are in most cases passively ventilated.

Since the installation and initial operation of the SHMS, several minor design and data-related problems have been encountered. These problems include the following.

- Five existing SHMS (101-A, 101-AX, 102-S, 102-SX, and 103-U) are consistently accumulating water within the sample gas filters and other components. It is anticipated that this will also be a problem in the planned 106-C SHMS.

- The 103-AX SHMS sample inlet probe and line is consistently being clogged by an unidentified green substance. This has prevented operation of the system since initial startup attempts.

- Two planned (106-C and 102-AX) and four existing SHMS (101-A, 101-AX, 103-AX, and 101-AW) are not tied into the Tank Monitoring and Control System (TMACS) and require local data loggers. Lack of data logging complicates efforts for continuous and efficient data recording and collection because the local recorder is a strip-chart recorder.

1.2 Objective

ARES Corporation has been contracted by Westinghouse Hanford Company (WHC) to investigate these problems and develop engineered solutions and design modifications. This report documents the solutions and provides required engineering documentation [i.e., Engineering Change Notices (ECNs) and/or drawings, and calculations for WHC review and approval], estimates, and implementation plans for proposed modifications.

2.0 SUMMARY

The water accumulation is believed to be caused by the dew point (moisture content) in the tank vapor space being higher than the temperature at which the monitoring equipment is maintained. This causes liquid condensation within the cooler SHMS components. A reliable and commercially proven system for removal of the moisture and return of the condensate to the tank can be applied to lower the vapor dew point while not impacting the measurement of the hydrogen gas. An installation design and procurement specification for this system is provided in Appendices A and B, respectively, and a cost estimate for implementation is included in Appendix C. The resulting total estimated project cost for tanks 101-A, 101-AX, 102-S, 102-SX, 103-U and 106-C is $247,000.

Analysis at the 222-S Laboratory of a sample of the green substance found in the 103-AX SHMS determined that it consists primarily of ammonium nitrate and unspecified organic material. The most likely origin of this is a gas phase reaction of ammonia (NH_3) and nitrogen dioxide (NO_2) creating ammonium nitrate. Another possibility is a thread cutting lubricant used in the sample tubing was not fully cleaned out. The organics could come from either the cleaning material or semi-volatile organics from the tank waste. Because the cause is uncertain, and since it is unknown if the problem is likely to reoccur, it is recommended that the system be back flushed and placed back in service to determine whether the problem has been eliminated. If the problem does continue, alternative solutions for further investigation are recommended.

A data logger that will allow easy retrieval of stored data was selected by WHC, and ARES Corporation prepared a design modification ECN to install the data logger on the SHMS for 101-A, 101-AX, 103-AX, 101-AW, and 106-C. The installation design is provided in Appendix D and a cost estimate for implementation is provided in Appendix E. The total cost for all five tanks is estimated to be $63,592.

3.0 DISCUSSION OF ISSUES AND RESOLUTIONS

As part of the discussion of issues and resolutions, a brief description of the SHMS is included here to enable the reader to more fully comprehend the reasoning behind the approaches taken in the solutions.

In the passively ventilated tanks, the samples are withdrawn from the tank via a 0.5 inch (1.3 cm) sample line (probe) inserted into a tank riser (refer to drawings H-2-85267 and H-2-85268). The probe is a minimum of 20 feet (6.1 m) in length in order to extend to within a few feet of the tank waste level. The sample is withdrawn at a rate of 1 SCFM (28.3 l/min) by a vacuum pump. The sample gas flow rate is currently in the process of being lowered to 0.5 SCFM (14.2 l/min) (Schneider 1996a). At the top of the riser where the probe is located, the sample gas stream transitions to a heat traced sample line for transport to the SHMS cabinet. When the sample gas stream enters the SHMS cabinet, it first goes through a moisture separator and then through two High-Efficiency Particulate Air (HEPA) filters. The SHMS cabinet is maintained between 70° and 90° F in order to protect cabinet electronics from extreme environmental conditions and provide for the best accuracy and response for the hydrogen monitor cell. At higher temperatures the sample cell is less accurate and has a slower response time.

3.1 Water Accumulation

3.1.1 Criteria

General design criteria for the hydrogen monitor is available in *Design Requirements and Criteria for a Hydrogen Monitoring System for Tanks 103-SY and 104-AN* (WHC 1991). The following are the applicable requirements from this document.

- The gas sampling tubing shall be sized so that the transit time from the sampling port to the exit port of the hydrogen monitor or the grab sampler shall be less than 30 seconds at a flow rate of 0.4 CFM.
- Enclosures for electrical or electronic components external to the tank shall meet requirements for National Electrical Manufacturers Association Type 4 enclosures.
- Equipment which comes in contact with the tank vapors shall comply with the requirements of ANSI/NFPA-70 for use in a Class I, Division I, Group B hazardous location. Installation of this equipment must also meet these requirements.

- External Environment:

  - Air temperature. -20° F. to 120° F.
  - Relative humidity. 5 percent to 100 percent.
  - Wind speed. Up to 80 miles per hour.
  - Moisture. Rain, snow, sleet, and hail.
  - Radiation. Up to 100 mr/hr.
  - Other. Blowing dust and sand. Nearby lightning strikes.

- The hydrogen monitoring system has been designated as a Safety Class 3 component. Design and analyses shall comply with requirements of WHC-CM-1-3, MRP 5.46. This reference has recently changed to WHC-CM-4-46, section 9.0 (WHC 1996), and the SHMS is now considered to be Safety Significant (Schneider 1996a).

Other requirements are as follows:

- It is desired to minimize, or be able to quantify, the amount of ammonia being removed from the gas sample stream as the system may be used to monitor for ammonia at a later date (Schneider 1996a).

3.1.2 Uncertainties

- The actual vapor space temperature and relative humidity of all the tanks of concern is not known. However, since original calculations for the vapor content were performed (see Appendix F) some sample analysis has shown a vapor content of between 13 and 15 mg/l in tank 101, 102, and 103-AX (see Table 3). This is about nine times less water than at saturated conditions for 120° F (48.9 °C). The quality of this data is not known.

- It is unknown at the time of this report whether the condensate accumulating in the SHMS cabinet would be classified as a dangerous or hazardous waste under Washington Administrative Code 173-303 (WAC 1995). However, a sample is being taken and sent to the 222-S Laboratory for analysis.

3.1.3 Discussion

All tanks that have a water accumulation problem are passively ventilated which allows the vapor space in the tank to approach saturation. Because the tanks have relatively high

radionuclide contents, they are much warmer than the sample tubing in the SHMS cabinet (70° to 90° F). The highest temperatures (WHC 1995) recorded in the tanks with SHMS water accumulation problems are:

Table 1

Tank	Temperature
101-A	154° F.
101-AX	136° F.
102-S	118° F.
102-SX	149° F.
103-U	88° F.
106-C	155° F.

It should be noted that because of the high salt content of these tanks the actual vapor pressure will be lower than the saturated pressure for these temperatures due to vapor point depression (a colligative property). The temperature at the surface of the waste is often more than 20° F cooler than the highest temperature in the tanks. Because of the high temperatures in the tank and associated moisture content, it is believed that the water accumulating in the SHMS system is caused by the vapor condensing once it reaches the cooler cabinet. Calculations in Appendix F show that relatively large amounts of water can accumulate in the sample lines in this manner. It should be noted that tank 103-U is somewhat of an anomaly because at this temperature, very little water should be seen condensing.

The only other possible source of liquid would be if the sample probes were of the wrong length and were actually submersed in the waste. This is not considered credible for three reasons.

- Only water has been observed in the sample lines, not high-level radioactive waste that is stored in the tanks.

- The minimum sample probe length is 20 feet and the specific gravity of the wastes is greater than 1.0. It is unlikely that even the SHMS sample pump which generates a suction head of up to 22 inches of Hg (24.9 feet of water) could pull the waste all the way out of the tank.

- The various sample probe lengths were confirmed to be correct in accordance with various drawings with the result that none of the probes contact the waste surface. Most sample probes came down no further than the top of the steel liner in the tanks, which is approximately two feet above the maximum allowed waste level in the tanks. On those tanks where the probe did come below this level, the actual waste level was determined to be well below the probe inlet using information from the waste tank summary report (WHC 1995).

Table 2
Sample Probe Height

Tank	Riser	Probe Length ECN 608113	Riser Flange to Top of Steel Liner	References
101-A	R-20	22'-0"	23'-0"	H-2-55911
101-AX	R-9F	24'-0"	21-3/4", approx. 30'-10" to waste	H-2-44560, H-2-44562, H-2-44571, WHC-EP-0182
103-AX	R-9G	26'-0"	21'-3/4", approx. 49'-10" to waste	H-2-44560, H-2-44562, H-2-44571, WHC-EP-0182
106-C	N/A	N/A	20'-0"	H-2-1744
102-S	R-1	20'-0"	22'-3"	H-2-1783
102-SX	R-2	24'-0"	23'-0", approx. 39'-0" to waste	H-2-39511, WHC-EP-0182
103-U	R-9	20'-0"	21'-9"	H-2-1742

3.1.4 Resolution

The proposed resolution for the water accumulation problem is to install a vapor condenser that will chill the gas sample stream down to a dew point of approximately

70° F or less. The condensate from the condenser will be routed directly back to the tank.

It was determined that a reasonable design point for the gas temperature exiting the tanks was 150° F at saturated conditions. The tanks can contain waste up to 300° F with a dome temperature to 250° F (WHC 1996b), but no tanks have a temperature approaching 200° F. Because the tanks with SHMS installed have temperatures less than 155° F, have a high salt content, and the vapor space is cooler than the highest temperature in the tank, it was determined that a design point of 150° F allowed for adequate flexibility without adding unnecessary and costly constraints to the design of the vapor condenser.

The vapor condenser will be located as close as possible to the sample probe riser so that the condensate can be easily routed back to the tank. The condenser and supporting equipment will be installed in a weather tight and environmentally controlled enclosure to allow for operation in temperatures down to -20° F and up to 110° F. The system will be able to operate above 110° F, but will not be able to lower the dew point to the desired 70° F. This is not anticipated to be a problem because when the ambient temperature is this high, the SHMS cabinet temperature is closer to 90°F. A peristaltic pump will be used to return the condensate to the waste tank. The condensate line would transition to stainless steel tubing prior to exiting the enclosure. The sample gas will be cooled in the condenser by a Peltier Effect (thermoelectric) chiller, or by a standard refrigerated chiller circulating glycol to the condenser. The refrigerated option is slightly less expensive, but is also bulkier and contains more moving parts than the thermoelectric chiller. For this reason, the Peltier Effect chiller was specified.

One potential problem that needs to be addressed with this solution is that it is desired to also utilize the SHMS to monitor for ammonia in some applications. This presents a problem in that ammonia is highly soluble, and the condenser will essentially act as a stripper to remove the ammonia from the air. Some scoping calculations using ammonia solubility information were performed in Appendix F to determine the amount of ammonia that could potentially be stripped. These calculations are essentially worst case and show that approximately 20 percent of the ammonia could be stripped in the case where there are low levels of ammonia (200 ppm) and high moisture content (150° F saturated). As the ammonia percent increases and the moisture content decreases, a smaller percentage of the ammonia will be stripped. One way to reduce the amount of ammonia stripped is to minimize the gas/liquid contact in the condenser. In general, two types of condensers are available from sample gas conditioner manufacturers. One is an impinger type which is designed to minimize the gas/liquid interface and thereby reduce the amount of soluble gases that are removed with the condensed water. The other type is

a spiral wound heat exchanger which has greater gas/liquid contact and is, therefore, not as desirable in applications where soluble gases are to be monitored (e.g., ammonia). For this reason, an impinger type heat exchanger was specified.

Another possible design impact comes from the uncertainty as to whether the condensate would be classified as a dangerous or hazardous waste. It is considered to be fairly unlikely that it will be classified as a dangerous or hazardous waste, but if so, it is still not necessary to have the condensate return line double encased as long as a visual inspection for leaks is performed once a day in accordance with Washington Administrative Code 173-303-640 (WAC 1995b). Condensate samples from one of the SHMS is being sent to the 222-S Laboratory for analysis to determine whether it would be classified as a dangerous or hazardous waste. Because the sample results are not yet available, it was necessary to make a design decision based on engineering judgement. It was, therefore, determined that the best design solution was to leave the condensate return line as a singly encased line and to install a drip pan with a leak detector below the peristaltic pump which is the most likely place for a leak to occur. It should be noted that the condensate return will not be pressurized, and that the highest flow rate will be on the order of one to three ml/minute.

The installation designs for all tanks of concern are included in Appendix A, while a procurement specification detailing the requirements for the sample gas conditioner that will essentially be a custom application of an "off-the-shelf" conditioner is included in Appendix B.

Potential vendor/manufacturers for such a system are:

- Baldwin Environmental, Inc.
  Reno, NV 89511
  Ph: 702-828-1300
  Contact: Rob Daniel

- M&C Products - U.S.A.
  1111 Rancho Conejo Blvd., #401
  Newbury Park, CA 91320
  Ph: 806-376-5670
  FAX: 806-376-5671
  Contact: Bob Bertik

- PACE Environmental Products Inc.
  5240 West Coplay Road,
  Whitehall, PA 18052
  Ph: 610-262-3818
  FAX: 610-262-4445
  Contact: Peter Kosloff

- Universal Analyzers, Inc.
  1771 South Sutro Terrace
  Carson City, NV 89706
  Ph: 800-993-9309
  FAX: 702-883-6388
  Contact: Ted Barben

3.2 103-AX Green Substance

On May 2, 1996, a sample of the green substance from a portion of the 103-AX sample line in the SHMS cabinet was received by the 222-S Laboratory for analysis. A small portion was analyzed for energetic properties using Differential Scanning Calorimetry (DSC) and the remainder (0.23 grams) was dissolved in 25 ml of water for analysis of anions by Ion Chromatography, metals by Inductively Coupled Plasma (ICP) spectrometry, and Total Organic Carbon (TOC) by an unspecified method. Preliminary laboratory results were available May 17, 1996, and were forwarded to ARES Corporation on June 25, 1996 (Schneider 1996b). The sample results showed the substance to be approximately 50 percent nitrate (NO_3^-), 9 percent TOC, and no corresponding metal cation.

Because ICP will not detect complex cations, it was, therefore, suspected that the ammonium cation (NH_4^+) might be present. This was later confirmed when an updated sample report was forwarded to ARES Corporation that showed the liquid sample still contained about 10 percent ammonia (Schneider 1996c). This leaves approximately 31 percent of the sample mass unaccounted for. Most likely, the unaccounted portion of the sample is water. Complete sample results are included in Appendix G.

In discussions with the operator who first discovered the problem, the substance found was described as a highly viscous, pastel green material that appeared to be slightly moist. The possibility that the material was tank waste was ruled out because of the lack of radioactivity in the substance. This was confirmed on July 12, 1996, when in-tank videos showed that the sample probe was approximately 15 to 20 feet above the waste surface level.

3.2.1 Possible Sources

At this time, only two likely sources for the green substance have been identified. One is that the material may be a residual amount of a thread cutting lubricant that was used in assembly of the SHMS sample tubing and may not have been completely flushed from the sample line during fabrication. The other possibility is that ammonium nitrate is being generated in a gas-phase reaction between ammonia and nitrogen dioxide. The organics in the sample could be from either the cleaning material or from semi-volatile organics in the tank waste. It is also possible that it is some combination of these two sources. In either case, review of sample information and available literature does not conclusively point to one option or another as will be discussed here.

3.2.2 Discussion

- **Anchorlube G-771™**

  As stated previously, one possible source of the green substance is a thread cutting lubricant that was used in the assembly of the SHMS sample tubing. This material is known as Anchorlube G-771™. While this material has a green color to it, information on the composition from the manufacturer does not match the laboratory analysis results from the SHMS sample. Indeed the product contains no nitrates which was over 50 percent of the sample. However, a sample of the product was sent to the 222-S Laboratory for further analysis. No sample results are available yet. A detailed description of the product is included in the Material Safety Data Sheet contained in Appendix H.

- **Ammonium Nitrate Formation**

  As stated previously, the sample analysis determined that approximately 50 percent of the sample was nitrates, and 10 percent ammonia. Another 9 percent was TOC and the remainder was trace amounts of various elements. This leaves approximately 31 percent of the mass unaccounted for at this time, although this is most likely water. The source of the green coloration for the substance is likely from trace amounts of copper and chromium found in the sample.

  The most likely cause of the ammonium nitrate is the formation of it as an aerosol (a solid) in the vapor space above the tank waste and in the gas sample lines by the reaction of gaseous ammonia (NH_3) and nitrogen dioxide (NO_2). It is known that ammonia exists in many of the tank vapor spaces in concentrations as high as

100-200 ppm while nitrogen dioxide would likely only be seen at very low levels (1 ppm or less) due to the high pH of the tank wastes. Recent gas sample information from tanks 101-AX, 102-AX, and 103 AX contained the following results for ammonia and nitrogen oxides.

Table 3

Tank No.	Ammonia - NH_3 (ppmv)	Nitrous Oxide - N_2O (ppmv)	Nitrogen Oxide - NO (ppmv)	Nitrogen Dioxide - NO_2 (ppmv)	Water - H_2O (vol%)
101-AX	39-44	<12.6	0.08-0.12	<0.03	1.85
102-AX	30-36	50-51	0.13-0.2	<0.08	1.85
103-AX	37-44	23-24	0.15-0.38	<0.07	2.10

Because all analyses for nitrogen dioxide were listed as being below detectable limits, further information on the detectability of it in the presence of nitrogen oxides was investigated. This research yielded information on attempts to monitor gases from tank 241-SY-101 for nitrogen dioxide using grab samples analyzed by mass spectrometry and by using a continuous Fourier Transform Infrared analyzer (Pederson and Bryan 1994). No nitrogen dioxide was detected in this case, but the detection limit for nitrogen dioxide in the presence of higher concentrations of water vapor, nitrous oxide (N_2O), carbon dioxide (CO_2), and ammonia was determined to be approximately 0.1 ppm. Although no nitrogen dioxide was detected, the study also showed that there are mechanisms by which various oxides of nitrogen (including nitrogen dioxide) may be produced by radiolytic and subsequent chemical processes.

The mechanism for the reaction of small concentrations of ammonia with nitrogen dioxide to form ammonium nitrate was established by F. Falk in 1954 (cited in Mearns 1984) to be:

$$2NH_3\,(g) + 2NO_2\,(g) \rightleftharpoons N_2\,(g) + H_2O\,(g) + NH_4NO_3\,(s) \qquad (1)$$

Using two different reaction rate equations (Falk 1955 and Naser 1983), Pederson and Bryan calculated the possible formation rates of ammonium nitrate in tank 241-SY-101. The same methods are used here in order provide information on the amount of ammonium nitrate that could be forming in tank 103-AX. It should be noted that there is a wide discrepancy in the results of the rate equations used due to differing conditions of

temperature and moisture content. The purpose here is not to revisit the determination of how much is forming, but whether it is likely that as much as was seen in 103-AX could be forming. The first rate equation used is from Falk where:

$$-dP(NO_2)/dt = k_a P(NH_3) P^2 (NO_2) + k_b P(H_2O) P^2 (NO_2) \qquad (2)$$

Where k_a and k_b are rate constants, P represents the partial pressures of the indicated species, and where no NO is assumed to be present initially. Rate constants k_a and k_b are determined from the Arrhenius equation where for k_a the activation energy is reported as -12.8 kcal/mole and the pre-exponential factor is given as 5.018×10^{-6} atm^{-2} s^{-1}, while for k_b the activation energy is -7 kcal/mole and the pre-exponential factor is 8.219×10^{-4} atm^{-2} s^{-1}. Using a tank vapor space volume which is approximated as 145,000 ft^3 we can determine the formation rate in the vapor space by assuming the gas phase concentrations for ammonia, nitrogen dioxide, and water remain at steady state. The calculations were run at 30° C for tank 103-AX using the conditions noted in Table 3 and resulted in a ammonium nitrate production rate of 4.72 grams per year or 0.091 grams per week. This is considerably less than the amount found in the sample line. It should also be noted though that the information on the nitrogen dioxide concentration is the most suspect, and the formation rate will increase with the square of the increase in nitrogen dioxide.

The other rate equation was developed by Naser to determine the ammonium nitrate formation rates in a cylinder with a given residence time. This can be used to compare results between the formation rate in the tank vapor space and the SHMS sample line where the residence time is low. Nasers rate equation for reactions in a tubular reactor is:

$$\tau = [1/k(1 - n)][C_{NO2}^{(1-n)}][1 - (1 - x_{NO2})]^{(1-n)} \qquad (3)$$

Where τ is the residence time in seconds, k is the rate constant which was determined to be 292 (mole/l)$^{-1.06}$ s^{-1}, n is the reaction order (2.06), C_{NO2} is the initial concentration of nitrogen dioxide in mole/l, and x_{NO2} is the nitrogen dioxide conversion factor or extent of reaction.

If we utilize a sample flow rate in the SHMS of 1 SCFM and a residence time of five seconds for the sample transport time we have the following Table 4 results for the ammonium nitrate formation.

Table 4

Calculation of the Quantity of Ammonium Nitrate Expected to be Formed in the SHMS Sample Line Based on the Rate Equation of Naser (1983) and assuming a Residence time of five seconds, and a Flow Rate of 1 SCFM.

NO_2 concentration, ppm	NO_2 moles/liter	extent of reaction	NH_4NO_3 moles/liter	NH_4NO_3 grams/yr
0.1	4.46E-09	2.05E-06	4.58E-15	5.45E-06
1.0	4.46E-08	2.36E-05	5.26E-13	6.26E-04
10.0	4.46E-07	2.71E-04	6.04E-11	7.18E-02

Table 5

Calculation of the Quantity of Ammonium Nitrate Expected to be Formed in Tank 103-AX Using the Rate Equation of Naser and Assuming a Reaction Volume of 145,000 ft^3 and a Tank Breathing Rate of 2440 ft^3/day.

NO_2 concentration, ppm	NO_2 moles/liter	extent of reaction	NH_4NO_3 moles/liter	NH_4NO_3 grams/yr
0.1	4.46E-09	6.70E-01	2.99E-09	7.0
1.0	4.46E-08	9.99E-01	4.46E-08	105.0
10.0	4.46E-07	9.95E-01	4.47E-07	1040.0

Using the method of Naser we not only come out with higher results, but we can also show that if ammonium nitrate is being formed, it is forming in the tank vapor space and then enters the SHMS gas sample tubing and is then deposited.

The fact that the most likely place for the ammonium nitrate aerosol to be deposited is the HEPA filter takes us to one of the first anomalies in that the green substance was not found at the HEPA filters, or even in the moisture separator. Instead it was found in and below a check valve on the upstream side of the filters. Why this would be so remains unexplained, but it is possible that there was some residual Anchorlube™ in this location and the ammonium nitrate aerosol adhered to this when it entered the check valve orifice.

Another anomaly is that the quantity of ammonium nitrate found in the sample line (0.19 g) is large compared to the amount that is predicted from the various rate equations. However, because 103-AX is passively ventilated we would expect to see a majority of any aerosol formed in the vapor space exit via the sample line as opposed to the breather filter on the tank. This is because the sample system samples at 1 SCFM (being lowered to 0.5 SCFM) while predicted breathing rates for the tanks based on barometric pressure changes are estimated to be:

$$\Delta V=V(0.00463) \qquad (4)$$

Where V is the volume of the tank vapor space in cubic feet and ΔV is the volumetric flow rate in cubic feet per day (Crippen 1993). Because 103-AX has only approximately 112,000 gallons of waste in a 1 million gallon tank, and the vapor space above a full tank is around 30,000 cubic feet, the breathing rate of the tank would be approximately 1,690 SCF per day as opposed to 1,440 SCF per day through the SHMS. Therefore, it is not unreasonable that a majority of the ammonium nitrate that forms and does not plate out on the walls of the tank, or simply settles back into the waste, would be found in the SHMS sample lines.

In summary, neither piece of evidence for the source of the green substance is conclusive. If it is ammonium nitrate from a gas phase reaction, we would not expect to find it in very great quantity due to the low amounts (if any) of nitrogen dioxide in the tanks. In addition, gas sample analyses of 101, 102, and 103-AX shows very similar results for ammonia and nitrogen oxide concentrations. If this is the case, it is unclear why the same substance is not seen in the other tanks? If the green substance is Anchorlube™, we would expect to see a much closer match with the sample analysis.

3.2.3 Safety Concerns

Anchorlube™ is a non-hazardous material that is used routinely in fabrication shop cleaning operations. It is non-reactive and does not represent a fire, explosive, or toxic hazard.

Ammonium nitrate on the other hand is often used in conjunction with an organic fuel as an explosive (Federoff 1960). This only occurs in much larger quantities than were found in the sample line, but information is included to show that the safety concerns are indeed minimal.

In general, ammonium nitrate is difficult to detonate accidentally and is considered relatively safe. However, a number of serious fires and explosions over the years that involved large amounts of ammonium nitrate have given rise to investigations of the hazards of ammonium nitrate (Wallace 1976). While it was recognized by early investigators that ammonium nitrate could be exploded by impact or a powerful detonator, very few recognized the possibility of exploding it by heat alone. A disaster involving two cargo ships carrying ammonium nitrate fertilizer at Texas City, Texas, in 1947 led to further investigations of the behavior of ammonium nitrate. These investigations showed that ammonium nitrate and mixes of it with organic materials can be caused to detonate by heating under conditions of confinement (Federoff 1960). Because heating under confinement is the only likely detonation scenario in the tanks or the SHMS, this is the area that will be focused on. There are two possible modes of heating ammonium nitrate: 1) heating from a fire or other external source (e.g., heating element), and 2) self-heating from the decomposition of ammonium nitrate.

- Fires and Other Heat Sources

  Wallace found that there is no way of predicting under exactly what circumstances a fire or fume-off reaction in ammonium nitrate can turn into an explosion. However, certain crude generalizations can be made: "(1) explosions are more likely to result with large amounts of ammonium nitrate than with small amounts, and (2) they are more likely to occur in confined places than in an unconfined one."

  Wallace further quotes F.A. Loving of the DuPont Potomac River Development Laboratory. Loving gave the following subjective assessment of the hazards involved: "He said that he would not hesitate to fight a fire involving 100 pounds of ammonium nitrate; he would be concerned about fighting one involving 1,000 pounds, and he would never fight a fire involving a boxcar load of ammonium nitrate, but would evacuate the area.

  Based on this information, the small amounts found in the SHMS, along with a lack of confinement in normal system configurations, would tend to suggest that an explosive hazard from a fire is not a concern.

  Federoff cites references that observed that under favorable conditions of pressure, rapid heating and retention of heat, ammonium nitrate may be exploded when heated to approximately 572° F (300° C). Wallace cites Loving as showing that ammonium nitrate that contains impurities (e.g., organic matter, sulfur,

sulfides, chlorides, zinc, and magnesium dust) is not stable at 225° F (107° C) or higher for prolonged periods (48 hours). It will eventually undergo rapid decomposition above these temperatures. DSC performed on the sample confirms the presence of a large exotherm beginning at about 437° F (225° C). A graph of the results is included in Appendix I.

Heat trace cables used in the SHMS sample lines are only capable of maintaining a maximum process temperature of 250° F (121° C) due to their self limiting nature of the cables. Therefore, even uncontrolled use of the heat trace is not considered a feasible ignition source.

- Self Heating

Because the decomposition of ammonium nitrate proceeds at a finite rate even at room temperature, if no heat is removed, the temperature will increase at an ever-increasing rate until a dangerous reaction ensues. Wallace calculated the critical masses necessary to cause a runaway reaction to occur in the vessel vent filters of Savannah River Site canyon buildings. With no air flow through the filters (conductive losses only) the worst case results that were obtained required 12 kg of ammonium nitrate for a spherical geometry with a surface temperature of 130° C and 7 kg of ammonium nitrate for a cylindrical geometry with a surface temperature of 130° C.

Again, with the small quantities present in the SHMS sample line, the chances are very remote that self heating could occur to the point where a dangerous reaction could occur.

- Other Mitigating Circumstances

The ammonium nitrate in the SHMS would rarely be found in the dry solid form that is the most unstable because ammonium nitrate is very hygroscopic and will go into solution any time the partial pressure of water in air rises above the vapor pressure of its saturated solution. This is approximately 60 percent relative humidity at 86° F (30° C) (Wallace 1976).

- Safety Concerns Summary

In summary, it seems highly unlikely that the small gram amounts of ammonium nitrate found in the SHMS gas sample lines would be a safety concern. The only

possible source of detonation is heating of the substance under confinement to high temperatures for which there is no credible mechanism for occurrence.

3.2.4 Recommendations

Because 103-AX is the only SHMS that the green substance has been known to have occurred in, and other tanks (notably 101-AX and 102-AX) have similar vapor space gas sampling results for ammonia and nitrogen oxides, it is recommended that the 103-AX SHMS sample lines be back flushed with water, dried, and placed back in service to see if the problem reoccurs. It is possible that the problem may not occur again, or may be resolved by periodic back flushing with water.

If the problem does recur at a frequency where it is undesirable to periodically back flush the system in a manual manner, it may be desirable to develop and incorporate one of the following options.

- Automatic Back flush

  If routine (e.g., more often than once a week) back flushing is necessary it may be beneficial to permanently install a system that will perform these back flushes on an automatic basis. The system would be set up on a timer to reposition solenoid and/or solenoid operated air valves to perform a back flush with water, followed by drying with bottled air or nitrogen. One potential difficulty with this is that the back flush can only be performed upstream of the HEPA filters. The filters can not be back flushed with liquid without damaging them.

- Removal of Gas Reactants

  Another possible solution is to remove one or both of the reactants (ammonia and nitrogen dioxide) from the gas sample stream as close to the sample location as possible. This could be done by the use of a packed stripping column or perhaps by simply bubbling the gas through a series of bubblers filled with water. The solution (water) would need to be changed out regularly so that the system does not become saturated. This solution is problematic in that it is relatively expensive, and it also does not prevent the possibility of the sample tube below the stripper/bubbler from becoming clogged with ammonium nitrate. Another problem with this solution is that it has previously been stated that there is a desire to utilize the SHMS for monitoring of ammonia. It is not possible to selectively strip out the nitrogen dioxide and leave the ammonia, so this solution

would affect the ammonia sample results.

3.3 Data Logger

WHC selected a small standalone data logger that will be used in place of the strip chart recorder in SHMS cabinets are located where TMACS is not available. This data logger is a Westronics SmartView™ Recorder model SVC-300-10-21-011-0. This data logger can easily be mounted where the strip chart recorder is without any physical modifications to the mounting brackets. An ECN for the installation and wiring of this data logger is included in Appendix D.

The data logger contains a floppy disk drive which allows the operator to periodically download the data. This data can then be retrieved into any number of spread sheet based programs for review, manipulation, and analysis of the data. This will save numerous man-hours that are currently spent manually loading this information into spread sheets off the strip charts.

4.0 REFERENCES

Crippen, M.D., 1993, *Barometric Pressure Variations,* WHC-EP-0651, Westinghouse Hanford Company, Richland, Washington.

Falk, F., 1955, *Stoichiometry and Kinetics of the Gas Phase Reaction of Nitrogen Dioxide and Ammonia*, Ph.D. Dissertation, Princeton University, Princeton, New Jersey.

Federoff, B.T., 1960, *Encyclopedia of Explosives and Related Items, Volume 1,* Picatinny Arsenal, Dover, New Jersey.

Mearns, A.M., and K. Ofosu-Asiedu, 1984, *Ammonium Nitrate Formation in Low Concentration Mixtures of Oxides of Nitrogen in Ammonia*, Journal of Chem. Tech. Biotech, 34A, 350-354.

Naser, A.J., 1983, *Ammonium Nitrate HEPA Filter Loading Study Results*, SD-WM-TRP-003, Rockwell Hanford Operations, Richland, Washington.

Pederson, L.R. and S.A. Bryan, 1994, *Assessment of the Potential for Ammonium Nitrate Formation and Reaction in Tank 241-SY-101*, PNL-10067, Battelle Pacific Northwest National Laboratory, Richland, Washington.

Schneider, T.C., 1996a, *SHMS Information*, Record of Conversation with B.D. Groth, 96RL0617, ARES Corporation, Richland, Washington.

Schneider, T.C., 1996b, *Sample Results for AX103 Pipe Sample*, cc:mail message of June 25, 1996, forwarded to ARES Corporation from A.D. Rice, Westinghouse Hanford Company, Richland, Washington.

Schneider, T.C., 1996c, *Updated Results on Pipe Sample*, cc:mail message of July 10, 1996, forwarded to ARES Corp. from A.D. Rice, Westinghouse Hanford Company, Richland, Washington.

Wallace, R.M., 1976, *Ammonium Nitrate in the Vessel Vent System*, DPST-76-421, Technical Division - Savannah River Laboratory, Savannah River, South Carolina.

WHC 1991, *Design Requirements and Criteria for a Hydrogen Monitoring System for Tanks 103-SY and 104-AN*, WHC-SD-WM-CR-043, rev. 0, Westinghouse Hanford Company, Richland, Washington.

WHC 1994, *Standard -B Hydrogen Monitoring System, System Design Description*, WHC-SD-WM-SDD-055, rev. 0, Westinghouse Hanford Company, Richland, Washington.

WHC 1995, *Waste Tank Summary Report for Month Ending February 28, 1995*, WHC-EP-0182-83, Westinghouse Hanford Company, Richland, Washington.

WHC 1996, *Safety Analysis Manual*, WHC-CM-4-46, Westinghouse Hanford Company, Richland, Washington.

WHC 1996b, *Operating Specifications for Single-Shell Waste Storage Tanks,* OSD-T-151-00013, rev. D-10, Westinghouse Hanford Company, Richland, Washington.

4.1 State and Federal Regulations

WAC 1995a, *Dangerous Waste Regulations,* WAC 173-303, Washington Administrative Code.

WAC 1995b, *Tank Systems,* WAC-173-303-640, Washington Administrative Code.

4.2 Drawings

H-2-1742	H-2-1744	H-2-1783	H-2-37316
H-2-37343	H-2-37525	H-2-39511	H-2-44560
H-2-44562	H-2-44571	H-2-46162	H-2-44163
H-2-46188	H-2-46240	H-2-46293	H-2-61984
H-2-63840	H-2-68237	H-2-69156	H-2-69184
H-2-73388	H-2-73692	H-2-85267	H-2-85268
H-2-87275	H-2-91111	H-2-93668	H-2-815300
H-2-817851	H-2-817852	H-2-817853	H-2-820778
H-2-820784	H-2-820804		

Appendix A
Water Accumulation ECNs

ENGINEERING CHANGE NOTICE Page 1 of 14

1. ECN No. 625230 Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	3a. USQ Required?	4. Date
Supplemental [X] Direct Revision [] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	BD Groth, ARES Corporation, Richland, WA 946-3300	[X] Yes [] No	8/2/96
	5. Project Title/No./Work Order No. SHMS Sample Conditioning/ N2165	6. Bldg./Sys./Fac. No. 241 General	7. Approval Designator SQ
	8. Document Numbers Changed by this ECN (includes sheet no. and rev.) See Block 12	9. Related ECN No(s). See Block 12	10. Related PO No. N/A

11a. Modification Work	11b. Work Package No.	11c. Modification Work Complete	11d. Restored to Original Condition (Temp. or Standby ECN only)
[X] Yes (fill out Blk. 11b) [] No (NA Blks. 11b, 11c, 11d)		Cog. Engineer Signature & Date	N/A Cog. Engineer Signature & Date

12. Description of Change

Design Baseline Document - No
Engineering Task Number: ETN-94-0002

8. Document Numbers Changed by this ECN	9. Related ECN No(s).
H-2-817851, sh. 1, rev. 2	625231
H-2-817852, sh. 1, rev. 1	625232
H-2-817853, sh. 1, rev. 1	625233
H-2-817853, sh. 5, rev. 1	625234
H-2-817854, sh. 1, rev. 1	625235
H-2-818215, sh. 1, rev. 1	625238
H-2-818215, sh. 2, rev. 1	
H-2-817861, sh. 1, rev. 1	

This ECN provides changes to the SHMS in order to install a gas sample conditioning

13a. Justification (mark one)

Criteria Change	[]	Design Improvement	[X]	Environmental	[]	Facility Deactivation	[]
As-Found	[]	Facilitate Const	[]	Const. Error/Omission	[X]	Design Error/Omission	[]

13b. Justification Details

Water accumulation in certain SHMS systems from condensation requires that additional sample gas conditioning be performed in order to prevent plugging of the system.

14. Distribution (include name, MSIN, and no. of copies)

DB Engelman	L6-37 (1)	DT Lott	R3-25 (1)
JM Jones	S5-13 (1)	CC Scaief	S2-01 (1)
TC Schneider	L6-37 (1)	CV Vo	L6-37 (1)
DD Tate	L6-37 (1)	RE Raymond	S7-12 (1)
HW Henrikson	R3-28 (1)		
Tank Farm Information Center	R1-28 (1)		

RELEASE STAMP

A-7900-013-2 (11/94) GEF095

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1): 625230

15. Design Verification Required
[] Yes
[X] No

16. Cost Impact

ENGINEERING			CONSTRUCTION		
Additional	[]	$ N/A	Additional	[]	$ N/A
Savings	[]	$	Savings	[]	$

17. Schedule Impact (days)

Improvement	[]	N/A
Delay	[]	N/A

18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

SDD/DD	[X]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Tickler File	[]
Environmental Report	[]	Inspection Plan	[]	None	[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
N/A		

20. Approvals

Signature	Date	Signature	Date
OPERATIONS AND ENGINEERING		ARCHITECT-ENGINEER	
Cog. Eng. TC Schneider		~~PE~~ RL Fritz Proj Mgr RLF	8-16-96
Cog. Mgr. DB Engelman		QA	
QA HW Henrikson		Safety	
Safety		Design BD Groth BD Groth	8/15/96
Environ.		Environ.	
Other DT Lott		Other	
CC Scaief			
DD Tate			
		DEPARTMENT OF ENERGY	
		Signature or a Control Number that tracks the Approval Signature	
		ADDITIONAL	

CONSTRUCTION NOTES
NOT TO BE INCORPORATED ON DRAWINGS

1. Conductor shall be stranded copper with type THHN/THWN insulation of type and size indicated on attached pages.

2. Use galvanized rigid steel conduit above ground generally and where subject to mechanical damage, or installed in concrete pads exposed to weather. Use PVC conduit for underground runs. Install concealed conduit as directly as possible and with bend radii as long as practical.

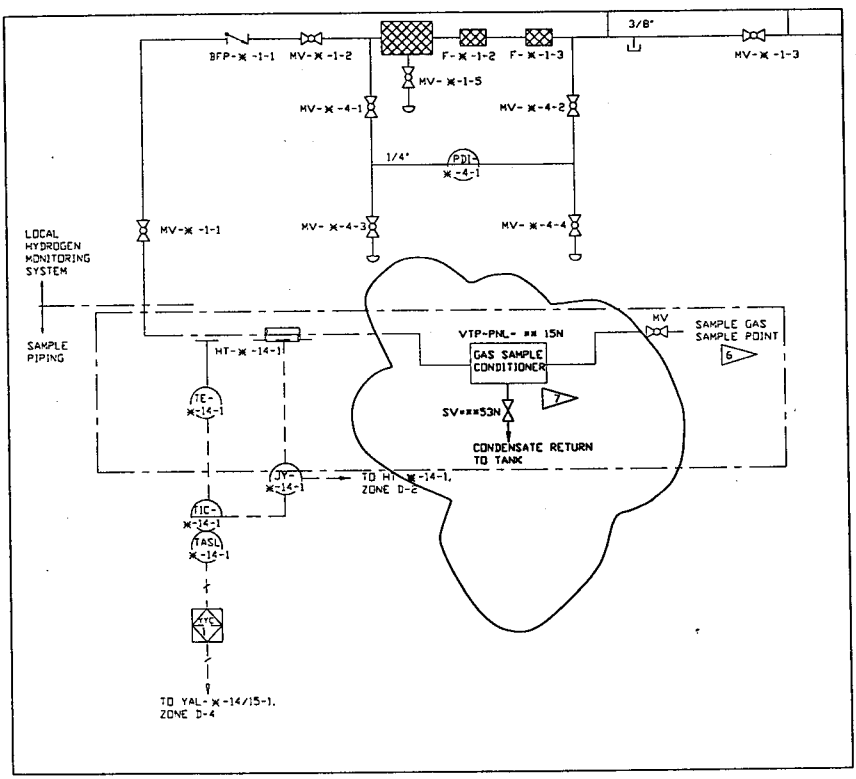
3. Install boxes firmly in position and plumb. Install dust covers on junction, pull boxes and other types of wiring outlets at installation. Replace with permanent covers or devices after wires are installed.

4. Do not bend cables installed in wireways to where the bend radii is less than ten times the cable diameter. Bind power conductors with cable ties at 18 inch intervals (maximum). Identify conductors by wire numbers shown on the drawings with wiremarkers.

5. Wiring shall be tested for continuity and isolation from ground prior to energizing.

6. It may be necessary to add additional terminal block mounting rail (p/n 104 on H-2-817853, sh. 5, rev. 1) in order to install additional breaker and terminal blocks.

ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-817851	1	2	ECN No. 625230	4 OF 14



(STANDARD HYDROGEN MONITORING SYSTEM)

ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-817851	1	2	ECN No. 625230	5 OF 14

GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

1. EQUIPMENT AND INSTRUMENTATION IDENTIFIERS PER H-2-99091, FLOW DIAGRAM IDENTIFICATION SCHEDULE.

2. USER-DEFINED ITEMS ARE AS FOLLOWS:
   - YAH - ALARM HORN
   - YAL - ALARM LIGHT
   - EB - INTRINSIC SAFETY BARRIER
   - BY - INTERPOSING RELAY

3. AREAS WITHIN PHANTOM LINES DENOTE COMPONENTS OUTSIDE CABINET.

4. DEVICES SO NOTED ARE INTRINSIC SAFETY APPARATUS.

5. EQUIPMENT AND INSTRUMENT DESIGNATOR DEFINITION:

   A B C D
   \ \ | /
   EXAMPLE: DPI-x-1-1

   A. EQUIPMENT/INSTRUMENT IDENTIFIER PER H-2-99091.
      1 2 3
      \ \ \
   B. EXAMPLE: 01 J SY
      1. LAST TWO DIGITS OF THE TANK NUMBER (101).
      2. TANK HYDROGEN MONITOR SEQUENTIAL IDENTIFIER (J THROUGH N).
      3. TANK FARM IDENTIFIER.
   C. SEQUENTIAL LOOP IDENTIFIER.
   D. SEQUENTIAL LOOP PART IDENTIFIER.

6. SEE THE REFERENCE DRAWING TABLE ON H-2-87275 FOR SAMPLE/RETURN POINT LOCATION.

7. VTP-PNL- ** ISN MAY BE ADDED BY ECN AS NECESSARY FOR MOISTURE REMOVAL. SEE H-2-87275 TO DETERMINE LOCATIONS INSTALLED.

   ** IS THE FARM NUMBER (A=8, AX=9, S=33, SX=34, U=38 ETC.), AND 'N' IS THE TANK NUMBER (101=A, 102=B, ETC).

(STANDARD HYDROGEN MONITORING SYSTEM)

ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
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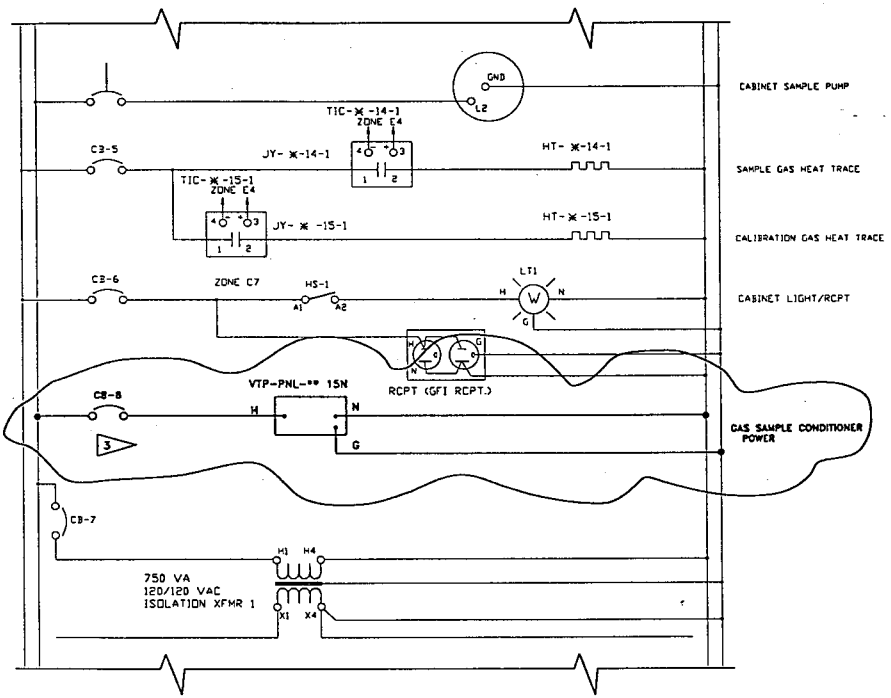
ELEMENTARY DIAGRAM

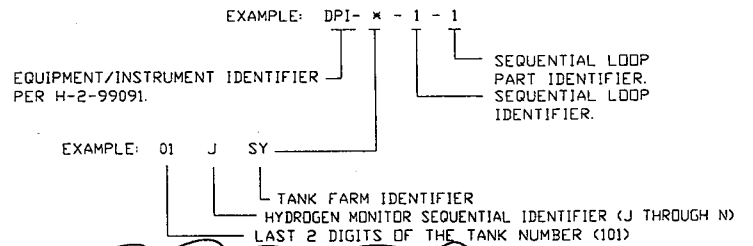


(STANDARD HYDROGEN MONITORING SYSTEM)

ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-817852	1	1	ECN No. 625230	7 OF 14

GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

1. ALL RELAY CONTACTS ARE SHOWN IN THE DEENERGIZED SHELF CONDITION.
2. ALL PROCESS ELEMENT DESIGNATORS ARE DEFINED BY FOLLOWING:



3. CB-8 IS ONLY INCLUDED ON SYSTEMS WHERE VTP-PNL-** 15N, SAMPLE GAS CONDITIONER IS INSTALLED SEE H-2-87275 FOR INSTALLED LOCATIONS.
4. NUMBERING SYSTEM FOR VTP-PNL-** 15N IS AS FOLLOWS: ** IS THE TANK FARM IDENTIFIER (A=8, AX=9, S=33, SX=34, U=38) AND "N" IS THE TANK IDENTIFIER (101=A, 102=B, ETC.).

(STANDARD HYDROGEN MONITORING SYSTEM)

ARES Corporation			ENGINEERING CHANGE NOTICE SKETCH	
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
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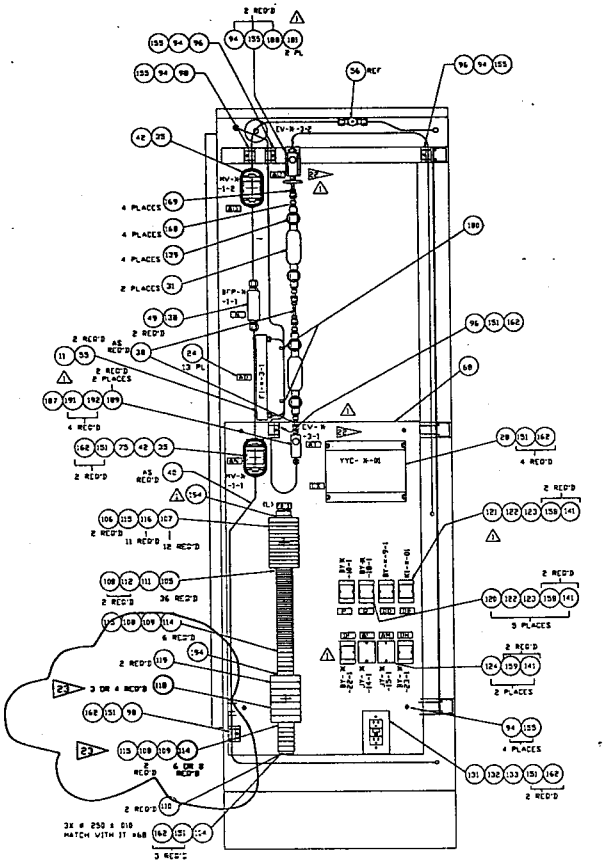

SECTION A-A

(STANDARD HYDROGEN MONITORING SYSTEM)

ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
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16> SEE INSTALLATION DRAWING H-2-87281 FOR INSTALLATION REQUIREMENTS. APPLICABLE DETAIL IS SHOWN ON THIS DRAWING.

17. PROVIDE CERTIFICATION OF TESTING 100% OF INSTALLED WIRING AS VERIFIED BY THE PERFORMING CRAFT. TEST WIRING FOR CONTINUITY (MAXIMUM 1 OHM) AND UNINTENTIONAL SHORTS (MINIMUM 200 MEGOHMS) WITH CALIBRATED TEST INSTRUMENTS CERTIFIED TRACEABLE TO NIST STANDARDS. REPAIR ALL VARIANCES.

18. PROVIDE CERTIFICATION OF PRESSURE LEAK TESTING OF ALL INSTALLED GAS TUBING WITH NITROGEN TO 30 ±2 PSIG IN ACCORDANCE WITH ASME B31.1 PARAGRAPH 137.5. ISOLATE INSTRUMENTATION THAT MIGHT BE DAMAGED BY THE TEST PRESSURE. REPAIR ALL LEAKS.

19> THE DIFFERENTIAL PRESSURE GAUGE SHALL BE ORDERED WITH A VITON DIAPHRAGM AND TEFLON COATED RANGE SPRING AND CERAMIC MAGNET.

20> THE FLOW METER SHALL BE ORDERED WITH CALIBRATION CERTIFICATION.

21> THE WHITTAKER ELECTRO CHEMICAL CELLS SHALL BE ORDERED WITH CALIBRATION CERTIFICATION.

22> INSTALL THE ASCO SOLENOID VALVES WITH THE "1" FACING DOWN AND THE "2" FACING UP.

23> **P/N 118 4 REQUIRED, AND P/N 114 8 REQUIRED ON SYSTEMS WHERE VTP-PNL-** 15N IS INSTALLED.**

(STANDARD HYDROGEN MONITORING SYSTEM)

ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-817854	1	1	ECN No. 625230	10 OF 14

GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

11. INSTALLATION SHALL CONFORM TO THE NEC-1993 EDITION.

12. PROVIDE CERTIFICATION OF TESTING 100% OF INSTALLED WIRING AS VERIFIED BY THE PERFORMING CRAFT. TEST WIRING FOR CONTINUITY (MAXIMUM 1 OHM) AND UNINTENTIONAL SHORTS (MINIMUM 200 MEGOHMS) WITH CALIBRATED TEST INSTRUMENTS CERTIFIED TRACEABLE TO NIST STANDARD. REPAIR ALL VARIANCES.

13. CB-8 AND TERMINAL BLOCKS 68 & 69 ARE ONLY INCLUDED ON SYSTEMS WHERE VTP-PNL-**15N IS INSTALLED. SEE H-2-87275. ** IS THE TANK FARM IDENTIFIER (A=8, AX=9, S=33, SX=34, U=38) AND "N" IS THE TANK IDENTIFIER (101=A, 102=B, ETC.)

(STANDARD HYDROGEN MONITORING SYSTEM)

ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
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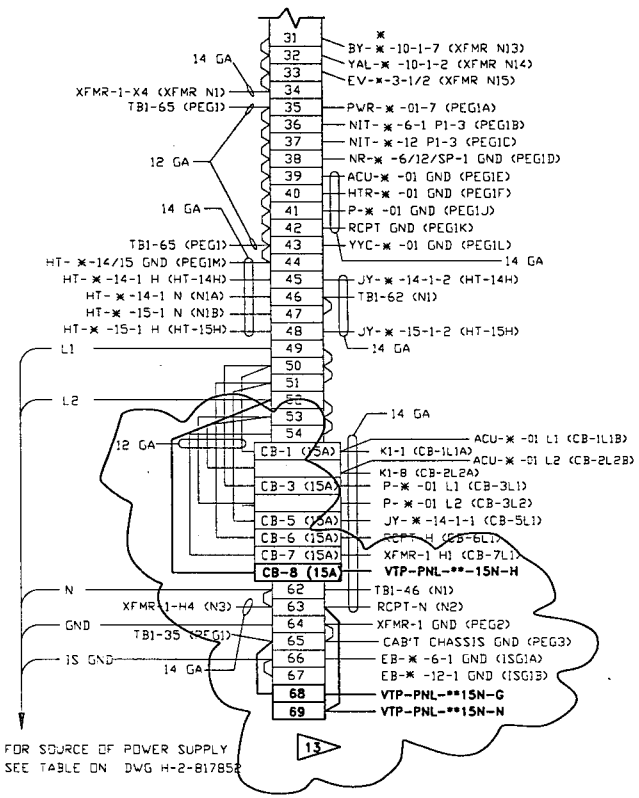
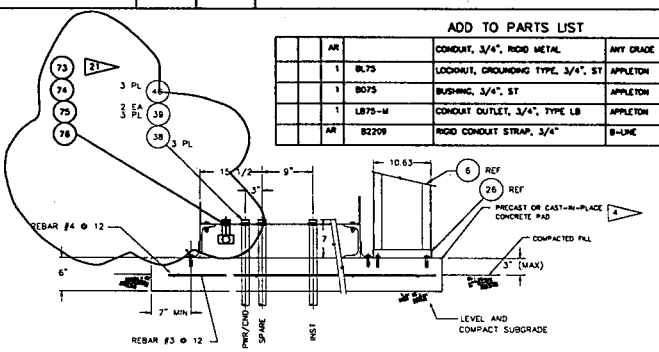


(STANDARD HYDROGEN MONITORING SYSTEM)

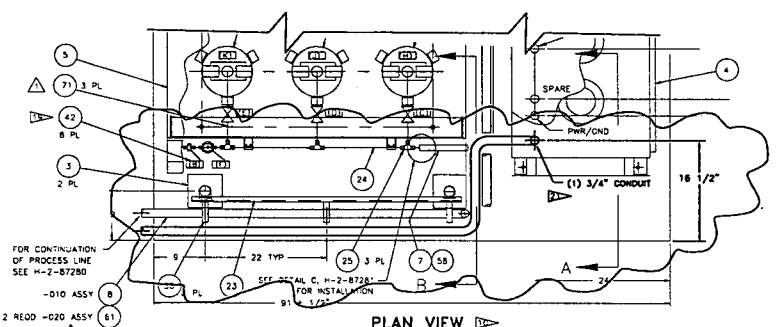
ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-818215	1	1	ECN No. 625230	12 OF 14

ADD TO PARTS LIST

	AR		CONDUIT, 3/4", RIGID METAL	ANY GRADE	73
	1	BL75	LOCKNUT, GROUNDING TYPE, 3/4", ST	APPLETON	74
	1	B075	BUSHING, 3/4", ST	APPLETON	75
	1	LB75-M	CONDUIT OUTLET, 3/4", TYPE LB	APPLETON	76
	AR	B2209	RIGID CONDUIT STRAP, 3/4"	B-LINE	77



VIEW A-A – SLAB PENETRATION & ANCHOR DETAIL
SCALE: 1/4" = 1"



PLAN VIEW

1 EQUIPMENT ARRANGEMENT W/ONE DUAL PROCESS LINE
SCALE: 1/8" = 1

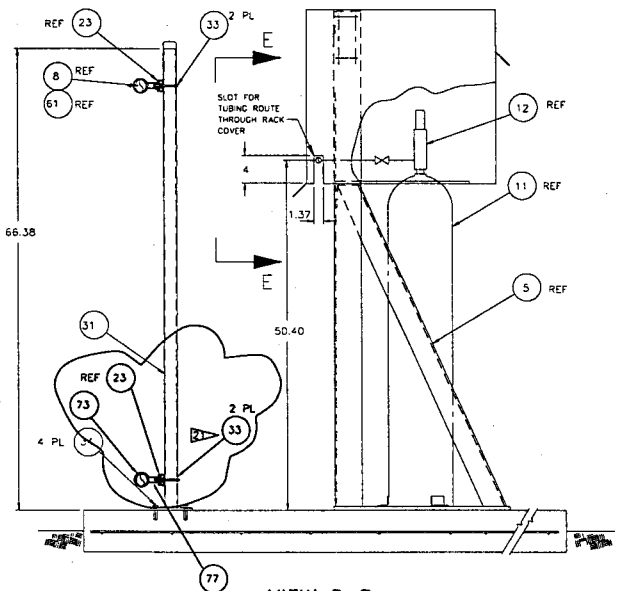
2 EQUIPMENT ARRANGEMENT W/TWO SINGLE PROCESS LINES
SCALE: 1/8" = 1

ADD GENERAL NOTE (21):

21. ONLY ON SYSTEMS WHERE THE GAS SAMPLE CONDITIONING CABINET IS INSTALLED.

(STANDARD HYDROGEN MONITORING SYSTEM)

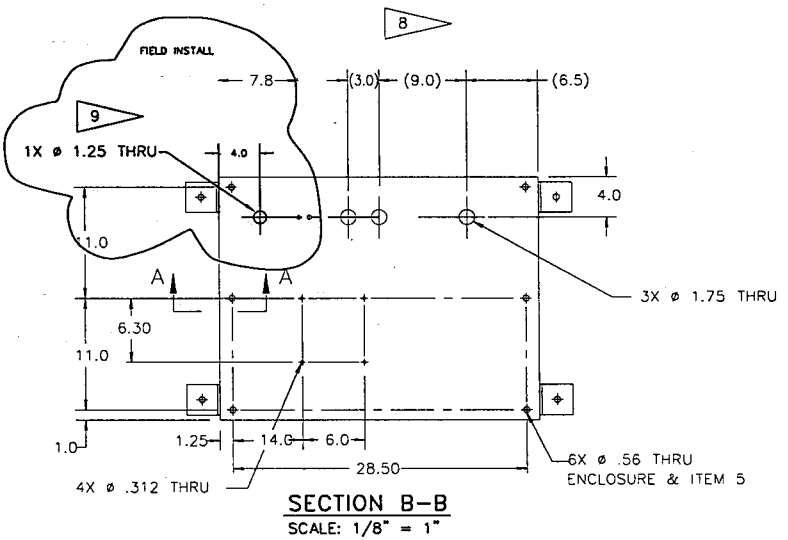
ARES Corporation			ENGINEERING CHANGE NOTICE SKETCH	
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-818215	2	1	ECN No. 625230	13 OF 14



VIEW B-B

(STANDARD HYDROGEN MONITORING SYSTEM)

ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-817861	1	1	ECN No. 625230	14 OF 14



SECTION B–B
SCALE: 1/8" = 1"

ADD GENERAL NOTE (9):

9. ONLY ON SYSTEMS WHERE GAS SAMPLE CONDITIONING CABINET IS INSTALLED.

(STANDARD HYDROGEN MONITORING SYSTEM)

ENGINEERING CHANGE NOTICE Page 1 of 11

1. ECN № 625231 Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	3a. USQ Required?	4. Date
Supplemental [X] Direct Revision [] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	BD Groth, ARES Corporation, Richland, WA 946-3300	[X] Yes [] No	8/2/96
	5. Project Title/No./Work Order No. SHMS Sample Conditioning/ N2165	6. Bldg./Sys./Fac. No. 241-A	7. Approval Designator SQ
	8. Document Numbers Changed by this ECN (includes sheet no. and rev.) See Block 12	9. Related ECN No(s). See Block 12	10. Related PO No. N/A

11a. Modification Work	11b. Work Package No.	11c. Modification Work Complete	11d. Restored to Original Condition (Temp. or Standby ECN only)
[X] Yes (fill out Blk. 11b) [] No (NA Blks. 11b, 11c, 11d)		Cog. Engineer Signature & Date	N/A Cog. Engineer Signature & Date

12. Description of Change

Design Baseline Document - Yes
Engineering Task Number: ETN-94-0002

8. Document Numbers Changed by this ECN	9. Related ECN No(s).
H-2-61984, sh. 1, rev. 6	625230
H-2-69184, sh. 1, rev. 5	608113
H-2-73388, sh. 1, rev. 4	W-369-5
H-2-69156, sh. 1, rev. 8	625238
H-2-91111, sh. 1, rev. 1	
H-2-91111, sh. 2, rev. 1	
H-2-87275, sh. 1, rev. 1	

This ECN provides installation design in order to install a gas sample conditioning system on the tank 241-A-101 SHMS.

13a. Justification (mark one)

Criteria Change	[]	Design Improvement	[X]	Environmental	[]	Facility Deactivation	[]
As-Found	[]	Facilitate Const	[]	Const. Error/Omission	[X]	Design Error/Omission	[]

13b. Justification Details

Water accumulation in certain SHMS systems from condensation requires that additional sample gas conditioning be performed in order to prevent plugging of the system.

14. Distribution (include name, MSIN, and no. of copies)

DB Engelman	L6-37 (1)	DT Lott	R3-25 (1)
JM Jones	S5-13 (1)	CC Scaief	S2-01 (1)
TC Schneider	L6-37 (1)	CV Vo	L6-37 (1)
DD Tate	L6-37 (1)	RE Raymond	S7-12 (1)
HW Henrikson	R3-28 (1)		
Tank Farm Information Center	R1-28 (1)		

RELEASE STAMP

A-7900-013-2 (11/94) GEF095

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1) 625231

15. Design Verification Required
[ ] Yes
[X] No

16. Cost Impact

ENGINEERING			CONSTRUCTION		
Additional	[X]	$4K	Additional	[X]	$20K
Savings	[ ]	$	Savings	[ ]	$

17. Schedule Impact (days)

Improvement	[ ]	N/A
Delay	[ ]	N/A

18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

SDD/DD	[X]	Seismic/Stress Analysis	[ ]	Tank Calibration Manual	[ ]
Functional Design Criteria	[ ]	Stress/Design Report	[ ]	Health Physics Procedure	[ ]
Operating Specification	[ ]	Interface Control Drawing	[ ]	Spares Multiple Unit Listing	[ ]
Criticality Specification	[ ]	Calibration Procedure	[ ]	Test Procedures/Specification	[ ]
Conceptual Design Report	[ ]	Installation Procedure	[ ]	Component Index	[ ]
Equipment Spec.	[ ]	Maintenance Procedure	[ ]	ASME Coded Item	[ ]
Const. Spec.	[ ]	Engineering Procedure	[ ]	Human Factor Consideration	[ ]
Procurement Spec.	[ ]	Operating Instruction	[ ]	Computer Software	[ ]
Vendor Information	[ ]	Operating Procedure	[ ]	Electric Circuit Schedule	[ ]
OM Manual	[ ]	Operational Safety Requirement	[ ]	ICRS Procedure	[ ]
FSAR/SAR	[ ]	IEFD Drawing	[ ]	Process Control Manual/Plan	[ ]
Safety Equipment List	[ ]	Cell Arrangement Drawing	[ ]	Process Flow Chart	[ ]
Radiation Work Permit	[ ]	Essential Material Specification	[ ]	Purchase Requisition	[ ]
Environmental Impact Statement	[ ]	Fac. Proc. Samp. Schedule	[ ]	Tickler File	[ ]
Environmental Report	[ ]	Inspection Plan	[ ]	None	[ ]
Environmental Permit	[ ]	Inventory Adjustment Request	[ ]		[ ]

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
N/A		

20. Approvals

Signature	Date	Signature	Date
OPERATIONS AND ENGINEERING		ARCHITECT-ENGINEER	
Cog. Eng. TC Schneider		PE RL Fritz for Proj. Mgr. RL Fritz	8-16-96
Cog. Mgr. DB Engelman		QA	
QA HW Henrikson		Safety	
Safety		Design BD Groth BD Groth	8/15/96
Environ.		Environ.	
Other DT Lott		Other	
CC Scaief			
DD Tate			
JM Jones		DEPARTMENT OF ENERGY	
		Signature or a Control Number that tracks the Approval Signature	
		ADDITIONAL	

CONSTRUCTION NOTES
NOT TO BE INCORPORATED ON DRAWINGS

1. Field route galvanized rigid steel conduit above ground generally and where subject to mechanical damage, or installed in concrete pads exposed to weather. Use PVC conduit for underground runs. Install concealed conduit as directly as possible and with bend radii as long as practical.

2. Install boxes firmly in position and plumb. Install dust covers on junction, pull boxes and other types of wiring outlets at installation. Replace with permanent covers or devices after wires are installed.

3. Do not bend cables installed in wireways to where the bend radii is less than ten times the cable diameter. Bind power conductors with cable ties at 18 inch intervals (maximum). Identify conductors by wire numbers shown on the drawings with wiremarkers.

4. Wiring shall be tested for continuity and isolation from ground prior to energizing.

5. Install gas sample conditioner footings, strut, and cabinet in the approximate orientation shown as dictated by field conditions.

6. Isolate sample supply and return lines from tank and reroute sample return line to sample gas conditioning cabinet.

7. Add insulated and heat traced condensate return line from sample conditioner back to sample return line by adding one new tee and valve at the return manifold. Splice heat trace around cabinet from the supply line to the condensate return line.

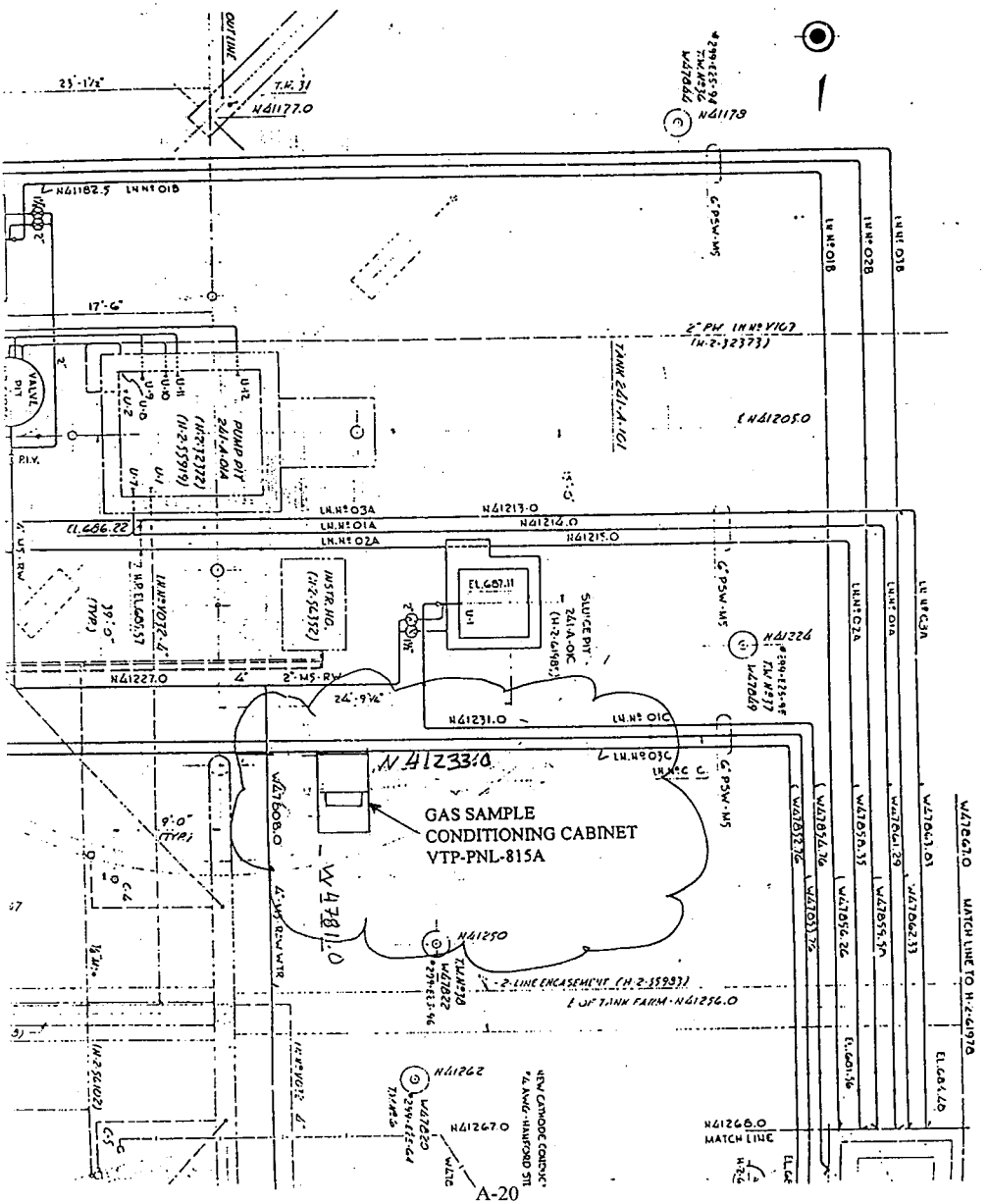
8. Seal ends of all insulated lines with heat shrink boots.

Add to Drawing H-2-87275, rev. 1, sh. 1

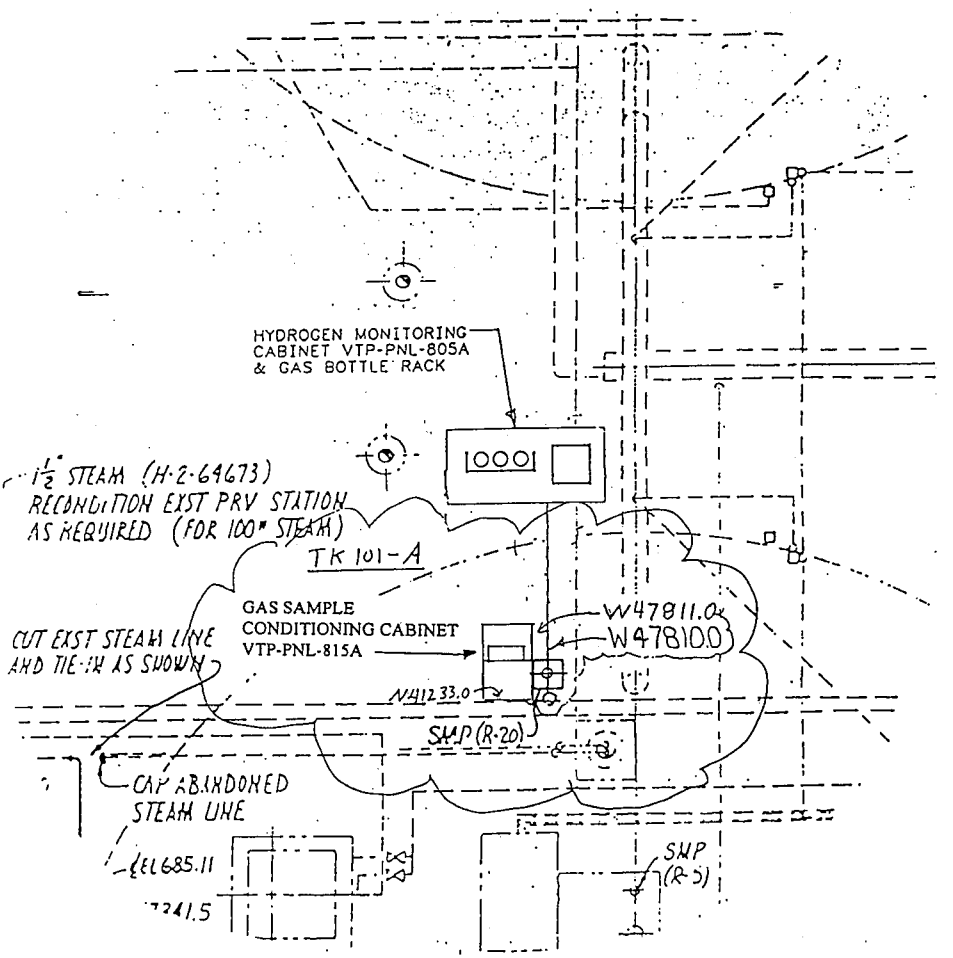
Add the following column to the STANDARD HYDROGEN MONITOR (SHMS) TABLE

Tank Farm	Tank Number	Sample Gas Conditioner Drawing (when installed)	Sample Gas Conditioner ECNs (when installed)
A	101	H-14-100859	625230, 625231
AN	103 104 105		
AW	101		
AX	101 103		
S	102 111 112		
SX	101 102 103 104 105 106 109		
SY	101 103		
T	110		
U	103 105 107 108 109		

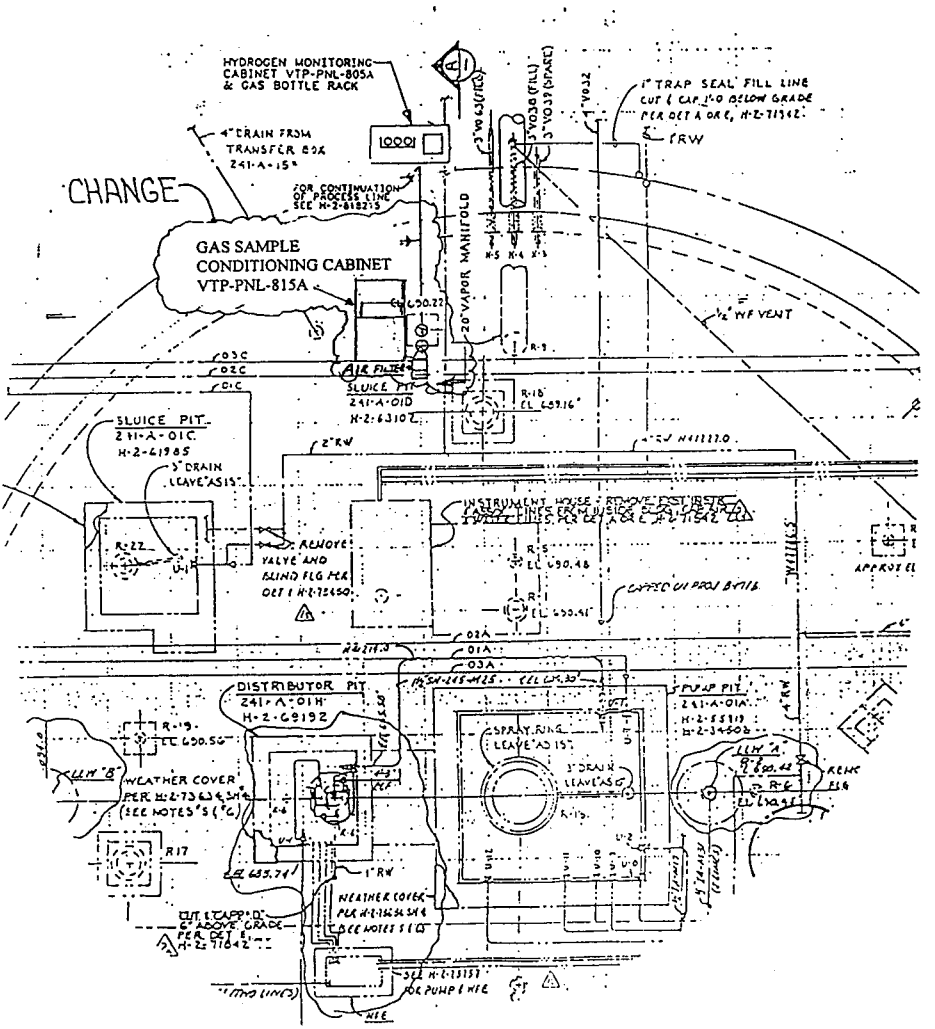
ARES Corporation			Engineering Change Notice Sketch		
Dwg. H-2-61984	Sh. 1	Rev. 6	Prepared by B.Groth	ECN No. 625231	Page 5 of 11



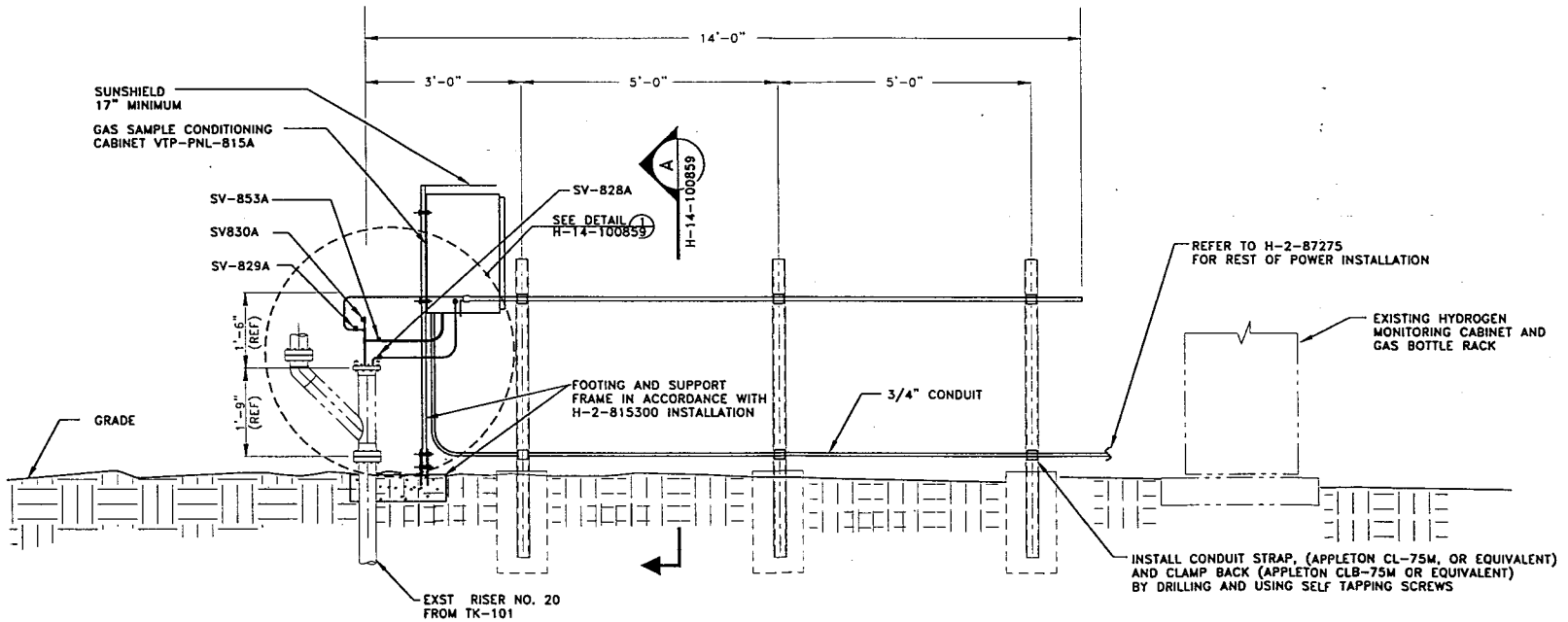
ARES Corporation			Engineering Change Notice Sketch		
Dwg. H-2-69184	Sh. 1	Rev. 5	Prepared by B. Groth	ECN No. 625231	Page 6 of 11



ARES Corporation			Engineering Change Notice Sketch		
Dwg. H-2-73388	Sh. 1	Rev. 4	Prepared by B.Groth	ECN No. 625231	Page 7 of 11

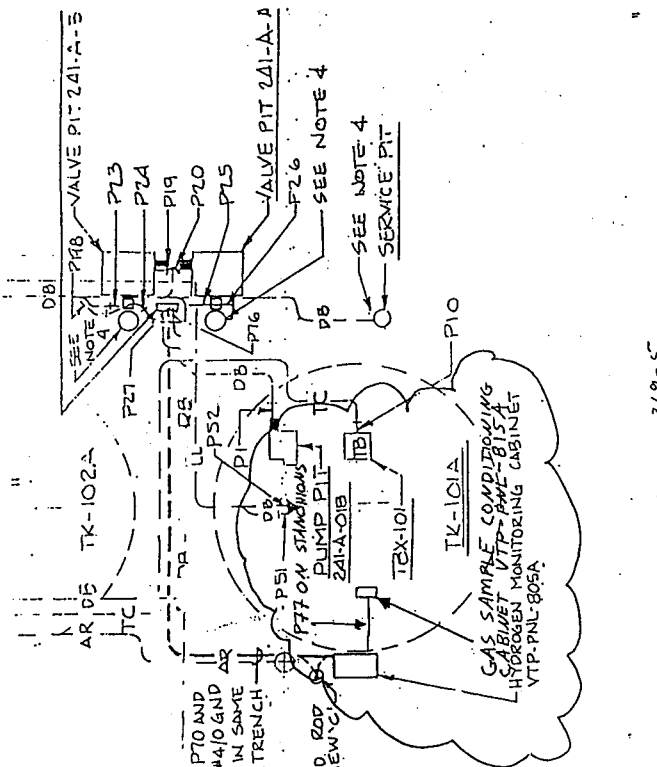


ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-73388	1	4	ECN No. 625231	8 OF 11



EQUIPMENT INSTALLATION ELEVATION TANK 101-A

ARES Corporation			Engineering Change Notice Sketch		
Dwg. H-2-69156	Sh. 1	Rev. 8	Prepared by B.Groth	ECN No. 625231	Page 9 of 11



ARES Corporation			Engineering Change Notice Sketch		
Dwg. H-2-91111	Sh. 1	Rev. 1	Prepared by B.Groth	ECN No. 625231	Page 10 of 11

CONDUIT SCHEDULE		
CND NO	CND SIZE	WIRE RUN NUMBERS
77	3/4	122

ARES Corporation			Engineering Change Notice Sketch		
Dwg. H-2-91111	Sh. 2	Rev. 1	Prepared by B.Groth	ECN No. 625231	Page 11 of 11

RE N O	NO OF WIRES	SIZE OF WIRE	TYPE OF WIRE	FROM	VIA	TO	WIRE NUMBERS
2	3	12	2	VTP-PNL-805A	P77	VTP-PNL-815A	VTP-PNL-815A-H,N,G

Add to Note 2.

THHN wire type

ENGINEERING CHANGE NOTICE

Page 1 of 11

1. ECN № 625232
Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	3a. USQ Required?	4. Date
Supplemental [X] Direct Revision [] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	BD Groth, ARES Corporation, Richland, WA 946-3300	[X] Yes [] No	8/2/96
	5. Project Title/No./Work Order No. SHMS Sample Conditioning/ N2165	6. Bldg./Sys./Fac. No. 241-AX	7. Approval Designator SQ
	8. Document Numbers Changed by this ECN (includes sheet no. and rev.) See Block 12	9. Related ECN No(s). See Block 12	10. Related PO No. N/A

11a. Modification Work	11b. Work Package No.	11c. Modification Work Complete	11d. Restored to Original Condition (Temp. or Standby ECN only)
[X] Yes (fill out Blk. 11b) [] No (NA Blks. 11b, 11c, 11d)		Cog. Engineer Signature & Date	N/A Cog. Engineer Signature & Date

12. Description of Change

Design Baseline Document - Yes
Engineering Task Number: ETN-94-0002

8. Document Numbers Changed by this ECN	9. Related ECN No(s).
H-2-63840, sh. 1, rev. 3	625230
H-2-68237, sh. 1, rev. 1	608113
H-2-69241, sh. 1, rev. 2	W-369-6
H-2-69156, sh. 1, rev. 8	625238
H-2-91111, sh. 1, rev. 1	
H-2-91111, sh. 2, rev. 1	
H-2-87275, sh. 1, rev. 1	

This ECN provides installation design in order to install a gas sample conditioning system on the tank 241-AX-101 SHMS.

13a. Justification (mark one)

Criteria Change	[]	Design Improvement	[X]	Environmental	[]	Facility Deactivation	[]
As-Found	[]	Facilitate Const	[]	Const. Error/Omission	[X]	Design Error/Omission	[]

13b. Justification Details

Water accumulation in certain SHMS systems from condensation requires that additional sample gas conditioning be performed in order to prevent plugging of the system.

14. Distribution (include name, MSIN, and no. of copies)

DB Engelman	L6-37 (1)	DT Lott	R3-25 (1)
JM Jones	S5-13 (1)	CC Scaief	S2-01 (1)
TC Schneider	L6-37 (1)	CV Vo	L6-37 (1)
DD Tate	L6-37 (1)	RE Raymond	S7-12 (1)
HW Henrikson	R3-28 (1)		
Tank Farm Information Center	R1-28 (1)		

RELEASE STAMP

A-7900-013-2 (11/94) GEF095

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1) 625232

15. Design Verification Required	16. Cost Impact				17. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[ ] Yes	Additional	[X] $4K	Additional	[X] $20K	Improvement	[ ] N/A
[X] No	Savings	[ ] $	Savings	[ ] $	Delay	[ ] N/A

18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

SDD/DD	[X]	Seismic/Stress Analysis	[ ]	Tank Calibration Manual	[ ]
Functional Design Criteria	[ ]	Stress/Design Report	[ ]	Health Physics Procedure	[ ]
Operating Specification	[ ]	Interface Control Drawing	[ ]	Spares Multiple Unit Listing	[ ]
Criticality Specification	[ ]	Calibration Procedure	[ ]	Test Procedures/Specification	[ ]
Conceptual Design Report	[ ]	Installation Procedure	[ ]	Component Index	[ ]
Equipment Spec.	[ ]	Maintenance Procedure	[ ]	ASME Coded Item	[ ]
Const. Spec.	[ ]	Engineering Procedure	[ ]	Human Factor Consideration	[ ]
Procurement Spec.	[ ]	Operating Instruction	[ ]	Computer Software	[ ]
Vendor Information	[ ]	Operating Procedure	[ ]	Electric Circuit Schedule	[ ]
OM Manual	[ ]	Operational Safety Requirement	[ ]	ICRS Procedure	[ ]
FSAR/SAR	[ ]	IEFD Drawing	[ ]	Process Control Manual/Plan	[ ]
Safety Equipment List	[ ]	Cell Arrangement Drawing	[ ]	Process Flow Chart	[ ]
Radiation Work Permit	[ ]	Essential Material Specification	[ ]	Purchase Requisition	[ ]
Environmental Impact Statement	[ ]	Fac. Proc. Samp. Schedule	[ ]	Tickler File	[ ]
Environmental Report	[ ]	Inspection Plan	[ ]	None	[ ]
Environmental Permit	[ ]	Inventory Adjustment Request	[ ]		[ ]

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
N/A		

20. Approvals

Signature	Date	Signature	Date
OPERATIONS AND ENGINEERING		ARCHITECT-ENGINEER	
Cog. Eng. TC Schneider		~~PE~~ RL Fritz RL Fritz Proj. Mgr 8-16-96	
Cog. Mgr. DB Engelman		QA	
QA HW Henrikson		Safety	
Safety		Design BD Groth BD Groth	8/15/96
Environ.		Environ.	
Other DT Lott		Other	
CC Scaief			
DD Tate			
JM Jones		DEPARTMENT OF ENERGY	
		Signature or a Control Number that tracks the Approval Signature	
		ADDITIONAL	

CONSTRUCTION NOTES
NOT TO BE INCORPORATED ON DRAWINGS

1. Field route galvanized rigid steel conduit above ground generally and where subject to mechanical damage, or installed in concrete pads exposed to weather. Use PVC conduit for underground runs. Install concealed conduit as directly as possible and with bend radii as long as practical.

2. Install boxes firmly in position and plumb. Install dust covers on junction, pull boxes and other types of wiring outlets at installation. Replace with permanent covers or devices after wires are installed.

3. Do not bend cables installed in wireways to where the bend radii is less than ten times the cable diameter. Bind power conductors with cable ties at 18 inch intervals (maximum). Identify conductors by wire numbers shown on the drawings with wiremarkers.

4. Wiring shall be tested for continuity and isolation from ground prior to energizing.

5. Install gas sample conditioner footings, strut, and cabinet in the approximate orientation shown as dictated by field conditions.

6. Isolate sample supply and return lines from tank and reroute sample return line to sample gas conditioning cabinet.

7. Add insulated and heat traced condensate return line from sample conditioner back to sample return line by adding one new tee and valve at the return manifold. Splice heat trace around cabinet from the supply line to the condensate return line.

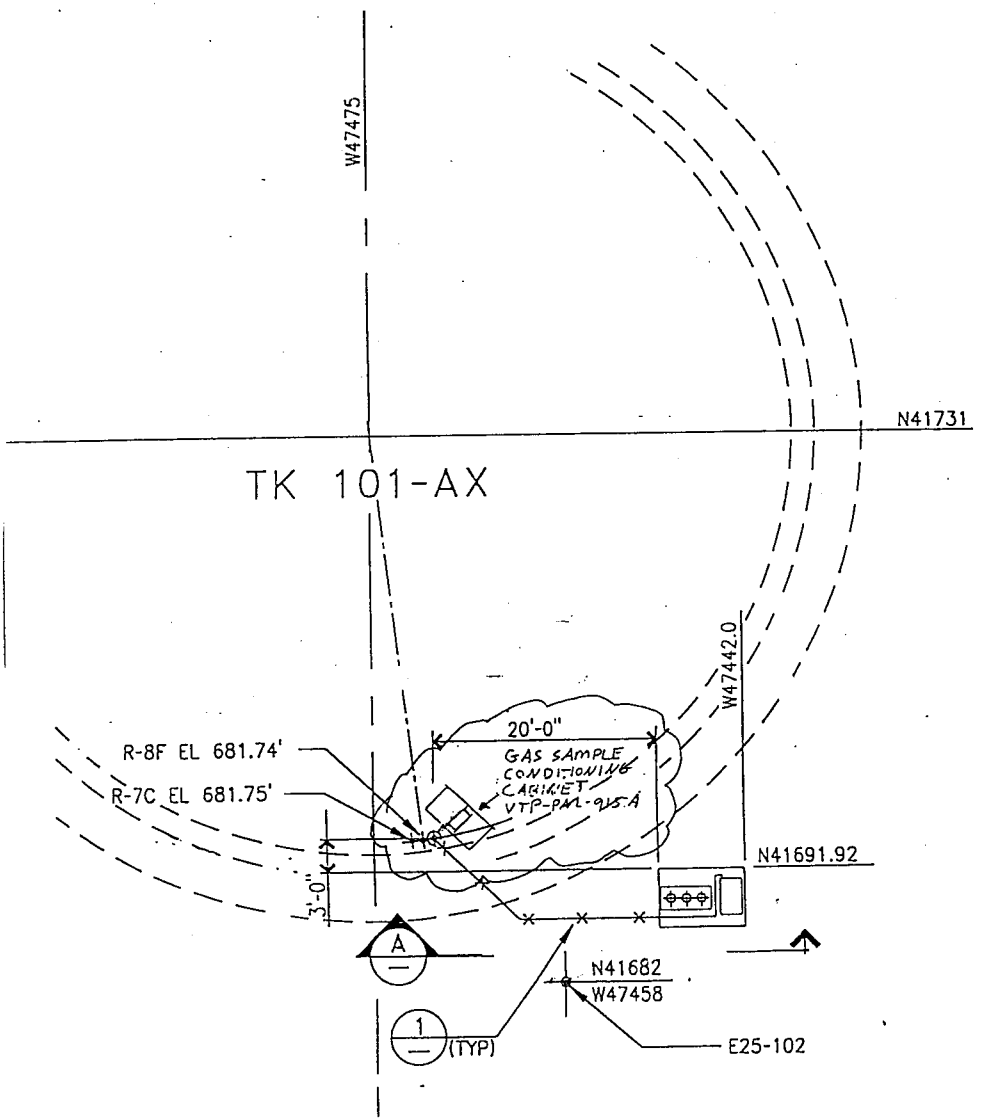
8. Seal ends of all insulated lines with heat shrink boots.

Add to Drawing H-2-87275, rev. 1, sh. 1

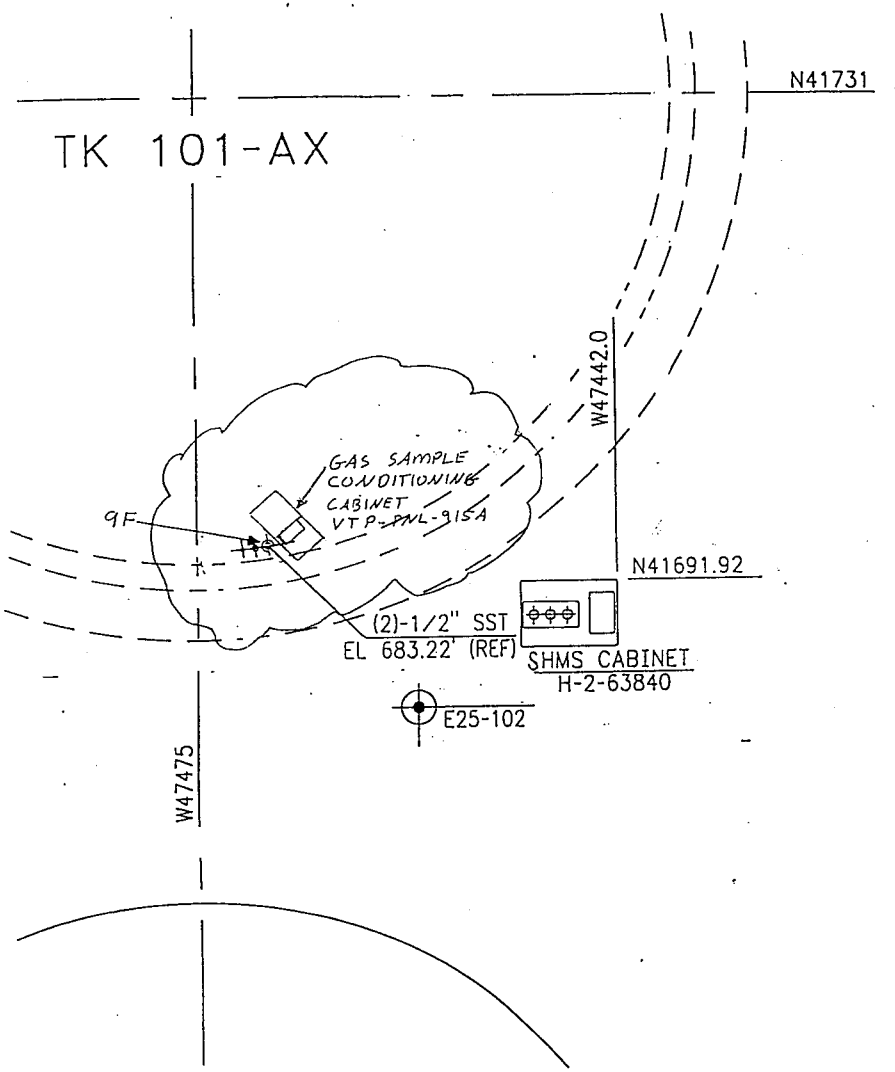
Add the clouded columns to the STANDARD HYDROGEN MONITOR (SHMS) TABLE

Tank Farm	Tank Number	Sample Gas Conditioner Drawings (when installed)	Sample Gas Conditioner ECNs (when installed)
A	101		
AN	103 104 105		
AW	101		
AX	101 103	H-14-100859	625230, 625232
S	102 111 112		
SX	101 102 103 104 105 106 109		
SY	101 103		
T	110		
U	103 105 107 108 109		

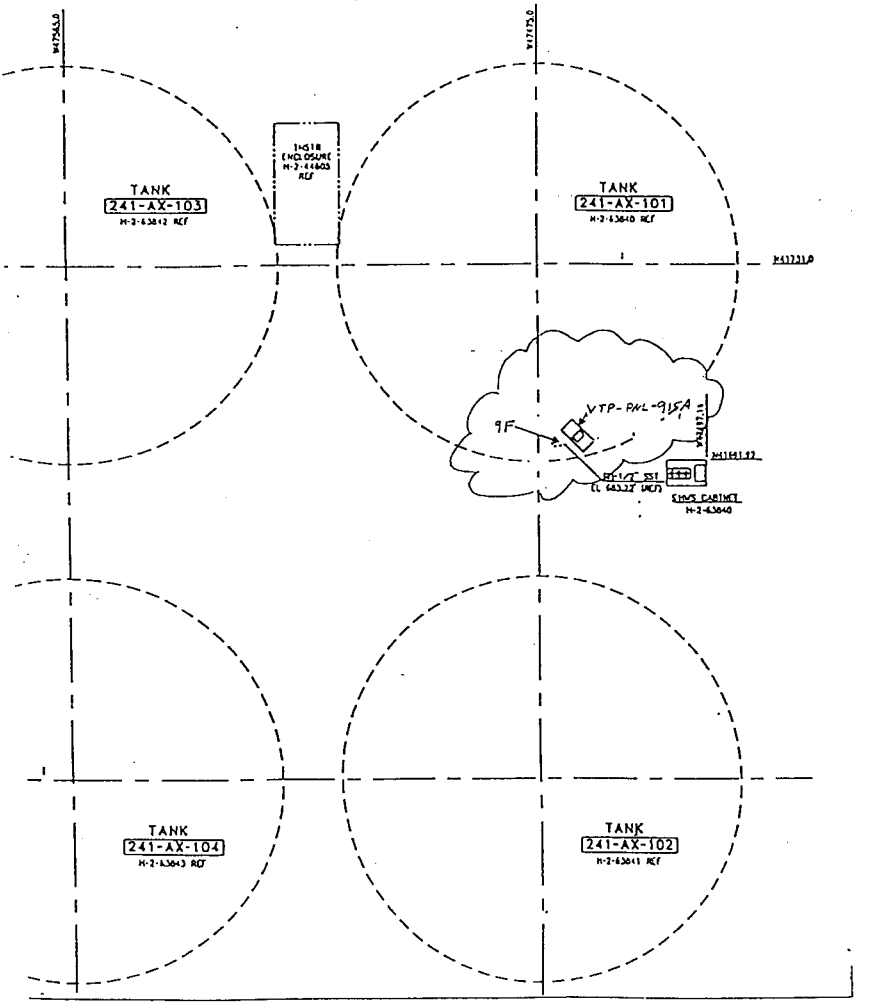
ARES Corporation			Engineering Change Notice Sketch		
Dwg. H-2-63840	Sh. 1	Rev. 3	Prepared by B.Groth	ECN No. 625232	Page 5 of 11



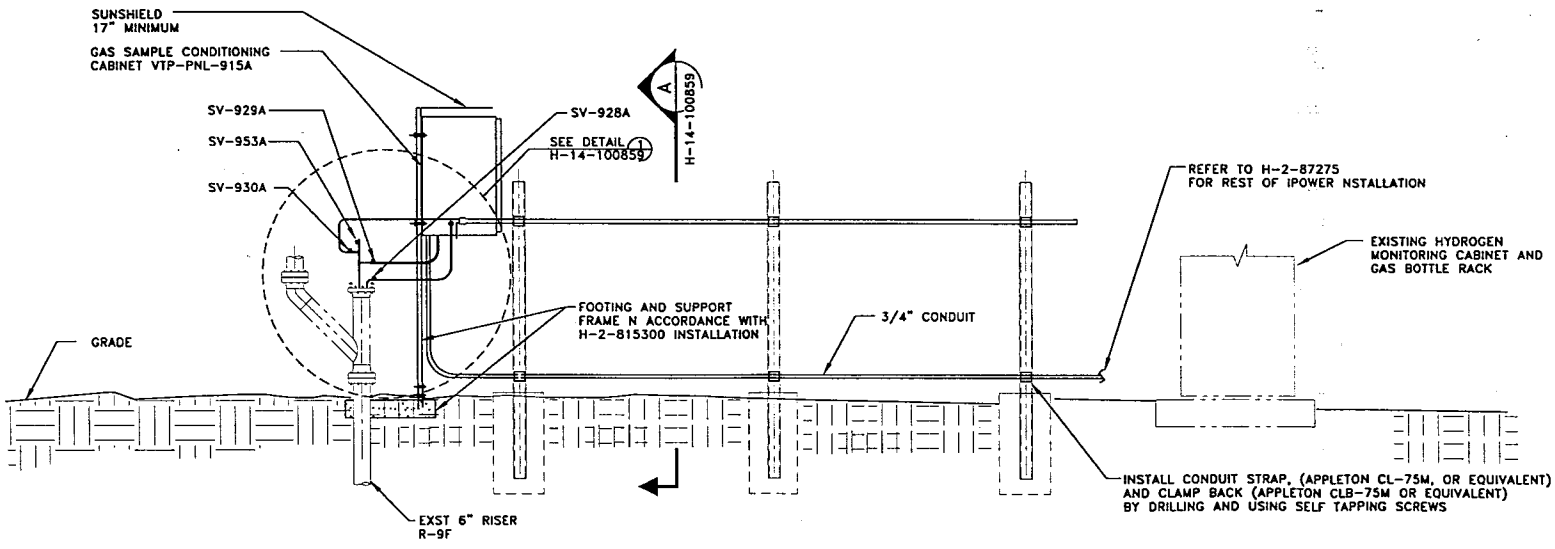
ARES Corporation			Engineering Change Notice Sketch		
Dwg. H-2-68237	Sh. 1	Rev. 1	Prepared by B.Groth	ECN No. 625232	Page 6 of 11



ARES Corporation			Engineering Change Notice Sketch		
Dwg. H-2-69241	Sh. 1	Rev. 2	Prepared by B.Groth	ECN No. 625232	Page 7 of 11

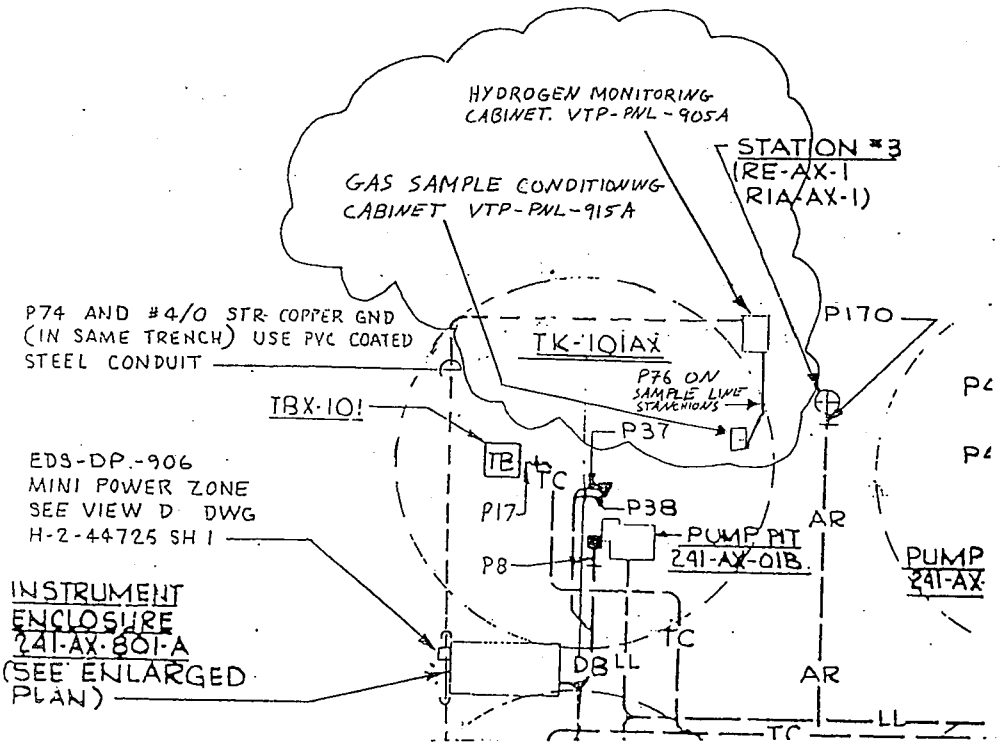


ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-63840	1	3	ECN No. 625232	8 OF 11



EQUIPMENT INSTALLATION ELEVATION TANK 101-AX

ARES Corporation			Engineering Change Notice Sketch		
Dwg. H-2-69156 ZONE F-1	Sh. 1	Rev. 8	Prepared by B.Groth	ECN No. 625232	Page 9 of 11



ARES Corporation			Engineering Change Notice Sketch		
Dwg. H-2-91111	Sh. 1	Rev. 1	Prepared by B.Groth	ECN No. 625232	Page 10 of 11

CONDUIT SCHEDULE		
CND NO	CND SIZE	WIRE RUN NUMBERS
76	3/4	121

ARES Corporation			Engineering Change Notice Sketch		
Dwg. H-2-91111	Sh. 2	Rev. 1	Prepared by B.Groth	ECN No. 625232	Page 11 of 11

RE :N O	NO OF WIRES	SIZE OF WIRE	TYPE OF WIRE	FROM	VIA	TO	WIRE NUMBERS
:1	3	12	2	VTP-PNL-905A	P76	VTP-PNL-915A	VTP-PNL-915A-H,N,G

Add to Note 2

THHN wire type

ENGINEERING CHANGE NOTICE

Page 1 of 10

1. ECN No 625233

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	3a. USQ Required?	4. Date
Supplemental [X] Direct Revision [] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	BD Groth, ARES Corporation, Richland, WA 946-3300	[X] Yes [] No	8/2/96
	5. Project Title/No./Work Order No. SHMS Sample Conditioning/ N2165	6. Bldg./Sys./Fac. No. 241-S	7. Approval Designator SQ
	8. Document Numbers Changed by this ECN (includes sheet no. and rev.) See Block 12	9. Related ECN No(s). See Block 12	10. Related PO No. N/A

11a. Modification Work	11b. Work Package No.	11c. Modification Work Complete	11d. Restored to Original Condition (Temp. or Standby ECN only)
[X] Yes (fill out Blk. 11b) [] No (NA Blks. 11b, 11c, 11d)		Cog. Engineer Signature & Date	N/A Cog. Engineer Signature & Date

12. Description of Change

Design Baseline Document - Yes
Engineering Task Number: ETN-94-0002

8. Document Numbers Changed by this ECN	9. Related ECN No(s).
H-2-37525, sh. 1, rev. 1	625230
H-2-46188, sh. 1, rev. 7	608113
H-2-820778, sh. 2, rev. 2	W-369-11
H-2-820778, sh. 5, rev. 2	625238
H-2-46162, sh. 1, rev. 3	
H-2-46163, sh. 1, rev. 4	
H-2-87275, sh. 1, rev. 1	

This ECN provides installation design in order to install a gas sample conditioning system on the tank 241-S-102 SHMS.

13a. Justification (mark one)

Criteria Change	[]	Design Improvement	[X]	Environmental	[]	Facility Deactivation	[]
As-Found	[]	Facilitate Const	[]	Const. Error/Omission	[X]	Design Error/Omission	[]

13b. Justification Details

Water accumulation in certain SHMS systems from condensation requires that additional sample gas conditioning be performed in order to prevent plugging of the system.

14. Distribution (include name, MSIN, and no. of copies)

DB Engelman	L6-37 (1)	DT Lott	R3-25 (1)
JM Jones	S5-13 (1)	CC Scaief	S2-01 (1)
TC Schneider	L6-37 (1)	CV Vo	L6-37 (1)
DD Tate	L6-37 (1)	RE Raymond	S7-12 (1)
HW Henrikson	R3-28 (1)		
Tank Farm Information Center	R1-28 (1)		

RELEASE STAMP

A-7900-013-2 (11/94) GEF095

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1) 625233

15. Design Verification Required	16. Cost Impact				17. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[ ] Yes	Additional	[X] $4K	Additional	[X] $20K	Improvement	[ ] N/A
[X] No	Savings	[ ] $	Savings	[ ] $	Delay	[ ] N/A

18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

SDD/DD	[X]	Seismic/Stress Analysis	[ ]	Tank Calibration Manual	[ ]
Functional Design Criteria	[ ]	Stress/Design Report	[ ]	Health Physics Procedure	[ ]
Operating Specification	[ ]	Interface Control Drawing	[ ]	Spares Multiple Unit Listing	[ ]
Criticality Specification	[ ]	Calibration Procedure	[ ]	Test Procedures/Specification	[ ]
Conceptual Design Report	[ ]	Installation Procedure	[ ]	Component Index	[ ]
Equipment Spec.	[ ]	Maintenance Procedure	[ ]	ASME Coded Item	[ ]
Const. Spec.	[ ]	Engineering Procedure	[ ]	Human Factor Consideration	[ ]
Procurement Spec.	[ ]	Operating Instruction	[ ]	Computer Software	[ ]
Vendor Information	[ ]	Operating Procedure	[ ]	Electric Circuit Schedule	[ ]
OM Manual	[ ]	Operational Safety Requirement	[ ]	ICRS Procedure	[ ]
FSAR/SAR	[ ]	IEFD Drawing	[ ]	Process Control Manual/Plan	[ ]
Safety Equipment List	[ ]	Cell Arrangement Drawing	[ ]	Process Flow Chart	[ ]
Radiation Work Permit	[ ]	Essential Material Specification	[ ]	Purchase Requisition	[ ]
Environmental Impact Statement	[ ]	Fac. Proc. Samp. Schedule	[ ]	Tickler File	[ ]
Environmental Report	[ ]	Inspection Plan	[ ]	None	[ ]
Environmental Permit	[ ]	Inventory Adjustment Request	[ ]		[ ]

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
N/A		

20. Approvals

Signature	Date	Signature	Date
OPERATIONS AND ENGINEERING		ARCHITECT-ENGINEER	
Cog. Eng. TC Schneider		PE RL Fritz - Proj. Mgr.	RL Fritz 8-16-96
Cog. Mgr. DB Engelman		QA	
QA HW Henrikson		Safety	
Safety		Design BD Groth	BD Groth 8/15/96
Environ.		Environ.	
Other DT Lott		Other	
CC Scaief			
DD Tate			
LF Dougherty		DEPARTMENT OF ENERGY	
		Signature or a Control Number that tracks the Approval Signature	
		ADDITIONAL	

CONSTRUCTION NOTES
NOT TO BE INCORPORATED ON DRAWINGS

1. Field route galvanized rigid steel conduit above ground generally and where subject to mechanical damage, or installed in concrete pads exposed to weather. Use PVC conduit for underground runs. Install concealed conduit as directly as possible and with bend radii as long as practical.

2. Install boxes firmly in position and plumb. Install dust covers on junction, pull boxes and other types of wiring outlets at installation. Replace with permanent covers or devices after wires are installed.

3. Do not bend cables installed in wireways to where the bend radii is less than ten times the cable diameter. Bind power conductors with cable ties at 18 inch intervals (maximum). Identify conductors by wire numbers shown on the drawings with wiremarkers.

4. Wiring shall be tested for continuity and isolation from ground prior to energizing.

5. Install gas sample conditioner footings, strut, and cabinet in the approximate orientation shown as dictated by field conditions.

6. Isolate sample supply and return lines from tank and reroute sample return line to sample gas conditioning cabinet.

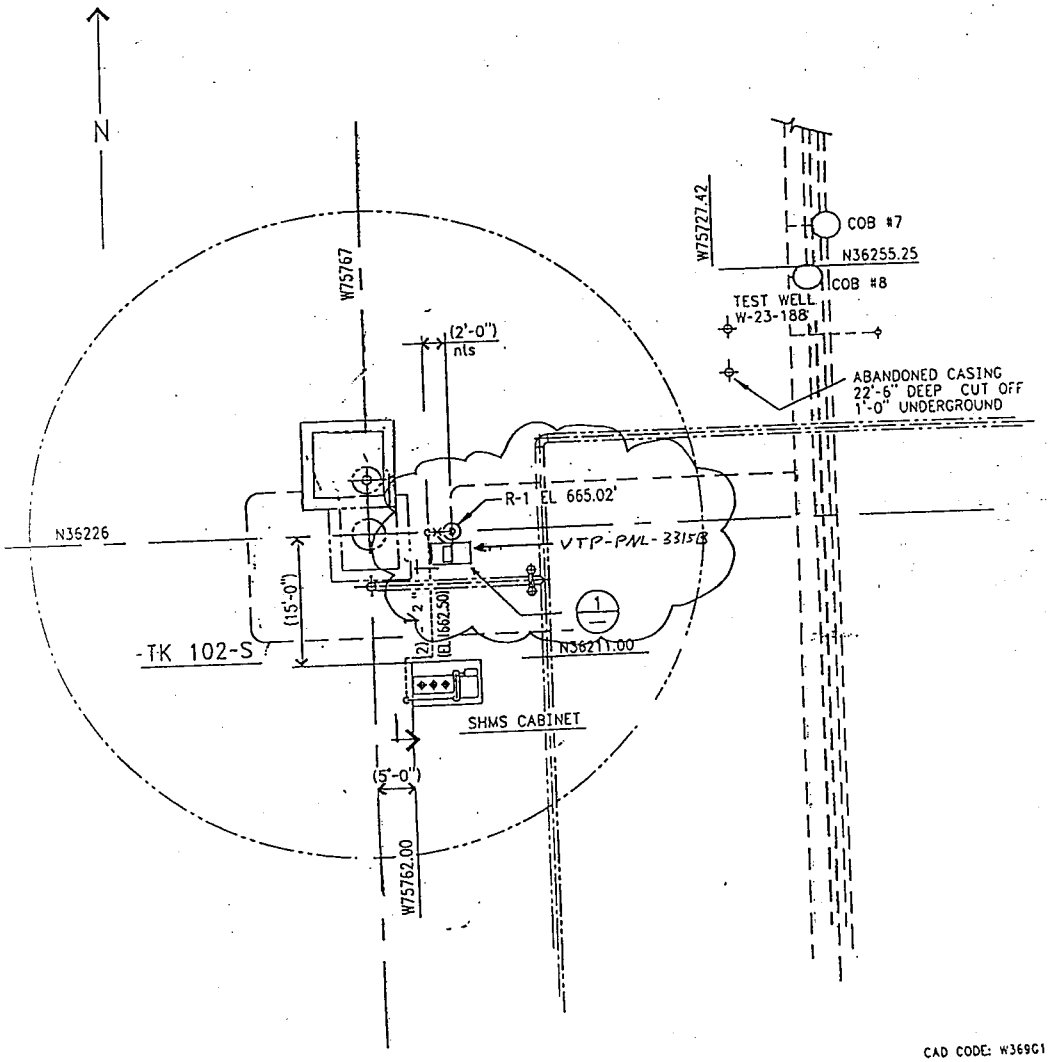
7. Add insulated and heat traced condensate return line from sample conditioner back to sample return line by adding one new tee and valve at the return manifold. Splice heat trace around cabinet from the supply line to the condensate return line.

8. Seal ends of all insulated lines with heat shrink boots.

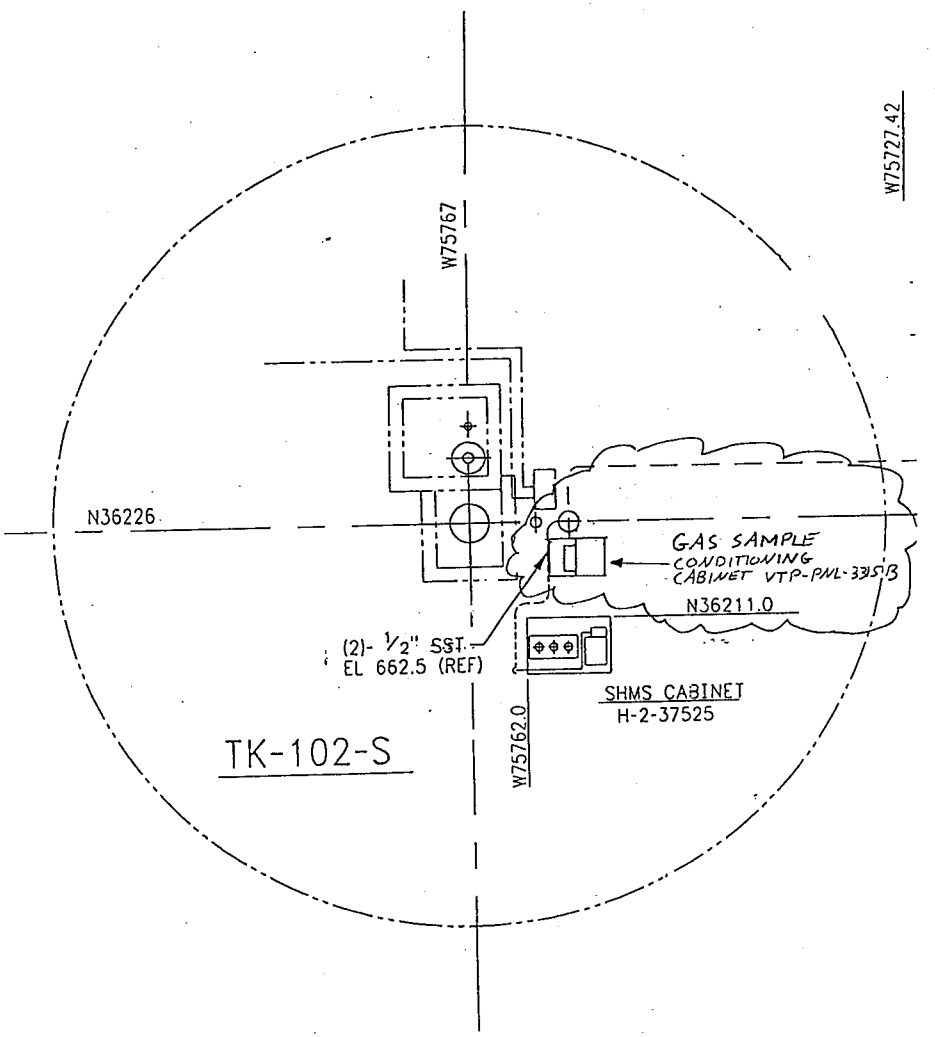
Add to Drawing H-2-87275, rev. 1, sh. 1

Add the following column to the STANDARD HYDROGEN MONITOR (SHMS) TABLE

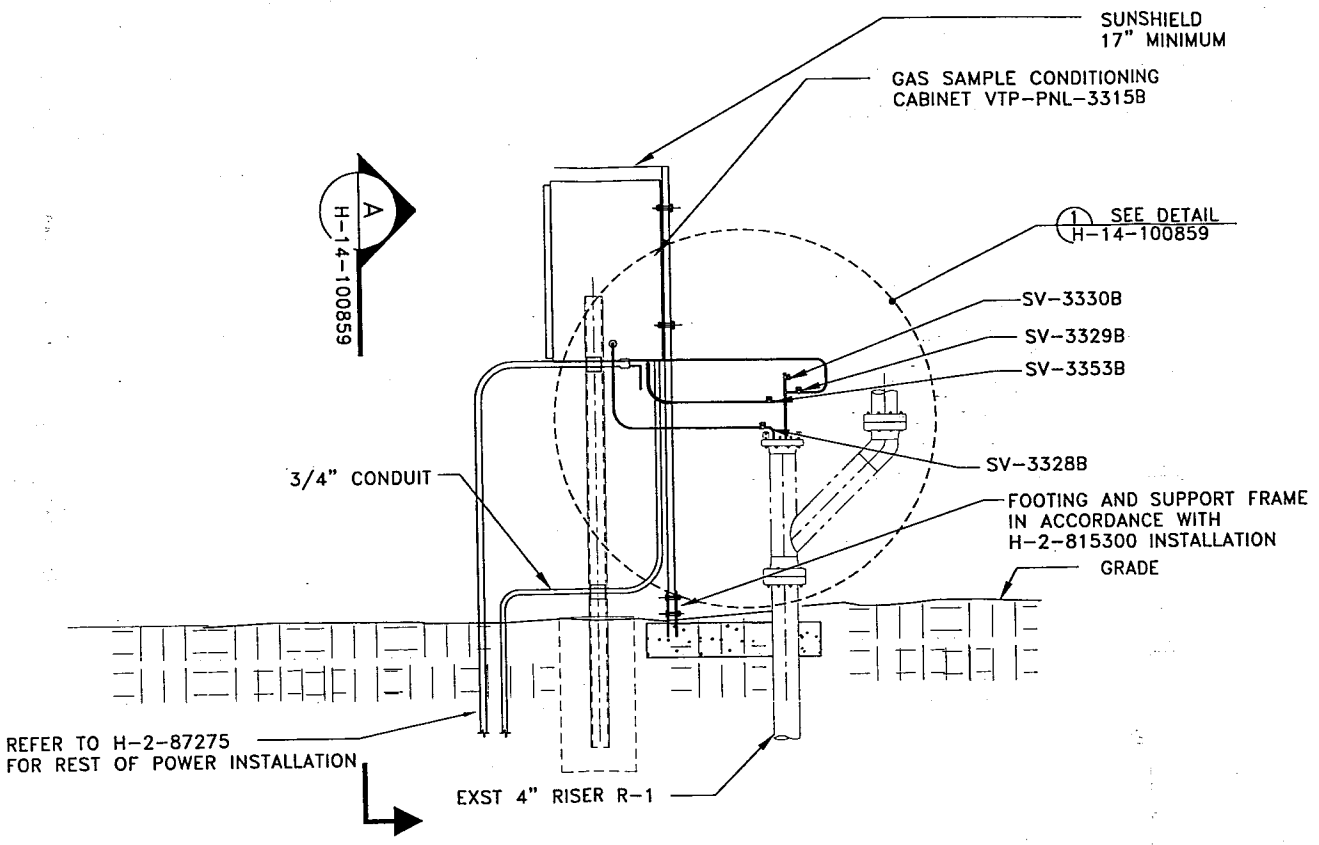
Tank Farm	Tank Number	Sample Gas Conditioner Drawing (when installed)	Sample Gas Conditioner ECNs (when installed)
A	101		
AN	103 104 105		
AW	101		
AX	101 103		
S	102 111 112	H-14-100859	625230, 625233
SX	101 102 103 104 105 106 109		
SY	101 103		
T	110		
U	103 105 107 108 109		


N
W75767
W75727.42
COB #7
N36255.25
COB #8
TEST WELL
W-23-188
(2'-0")
nts
ABANDONED CASING
22'-6" DEEP CUT OFF
1'-0" UNDERGROUND
R-1 EL 665.02'
N36226
VTP-PNL-3315B
(15'-0")
(2) 2" (EL 1662.50)
1
TK 102-S
N36211.00
SHMS CABINET
(5'-0")
W75762.00
CAD CODE: W369G1

ARES Corporation			Engineering Change Notice Sketch		
Dwg. H-2-46188	Sh. 1	Rev. 7	Prepared by B.Groth	ECN No. 625233	Page 6 of 10

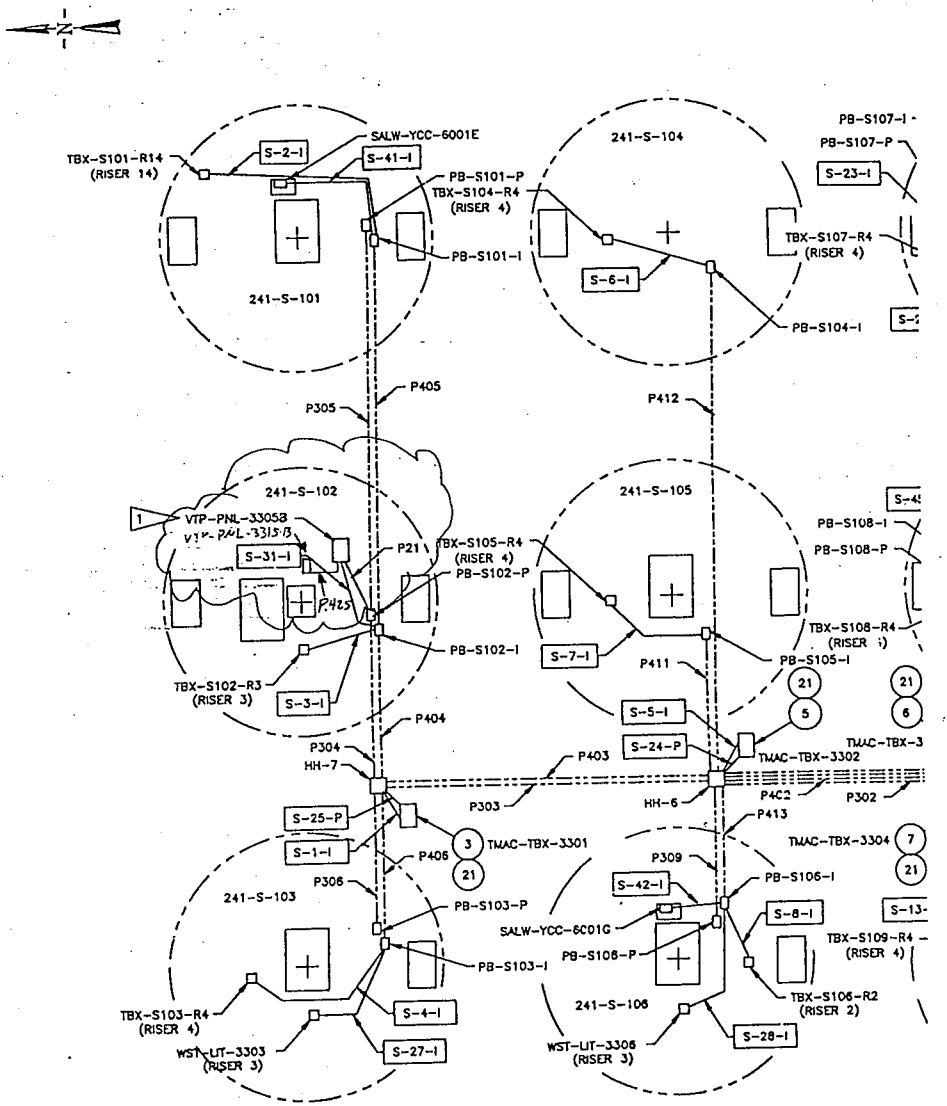


ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-37525	1	1	ECN No. 625233	7 OF 10



EQUIPMENT INSTALLATION ELEVATION TANK 102-S

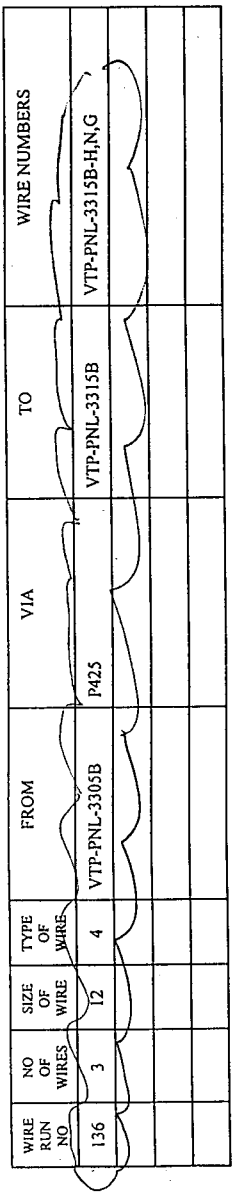
ARES Corporation			Engineering Change Notice Sketch		
Dwg. H-2-820778	Sh. 2	Rev. 2	Prepared by B.Groth	ECN No. 625233	Page 8 of 10



ARES Corporation			Engineering Change Notice Sketch		
Dwg. H-2-820778 H-2-46162	Sh. 5 1	Rev. 2 3	Prepared by B.Groth	ECN No. 625233	Page 9 of 10

CONDUIT SCHEDULE		
CND NO	CND SIZE	WIRE RUN NUMBERS
P425	3/4	136

ARES Corporation			Engineering Change Notice Sketch		
Dwg. H-2-820778 H-2-46163	Sh. 5 1	Rev. 2 4	Prepared by B. Groth	ECN No. 625233	Page 10 of 10



ENGINEERING CHANGE NOTICE

Page 1 of 9

1. ECN No 625234

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	3a. USQ Required?	4. Date
Supplemental [X] Direct Revision [] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	BD Groth, ARES Corporation, Richland, WA 946-3300	[X] Yes [] No	8/2/96
	5. Project Title/No./Work Order No. SHMS Sample Conditioning/ N2165	6. Bldg./Sys./Fac. No. 241-SX	7. Approval Designator SQ
	8. Document Numbers Changed by this ECN (includes sheet no. and rev.) See Block 12	9. Related ECN No(s). See Block 12	10. Related PO No. N/A

11a. Modification Work	11b. Work Package No.	11c. Modification Work Complete	11d. Restored to Original Condition (Temp. or Standby ECN only)
[X] Yes (fill out Blk. 11b) [] No (NA Blks. 11b, 11c, 11d)		Cog. Engineer Signature & Date	N/A Cog. Engineer Signature & Date

12. Description of Change

Design Baseline Document - Yes
Engineering Task Number: ETN-94-0002

8. Document Numbers Changed by this ECN	9. Related ECN No(s).
H-2-46293, sh. 1, rev. 3	625230
H-2-46240, sh. 1, rev. 4	608113
H-2-820784, sh. 2, rev. 2	W-369-12
H-2-46162, sh. 1, rev. 3	W-369-19
H-2-93668, sh. 1, rev. 1	625238
H-2-46163, sh. 1, rev. 4	
H-2-87275, sh. 1, rev. 1	

This ECN provides installation design in order to install a gas sample conditioning system on the tank 241-SX-102 SHMS.

13a. Justification (mark one)

Criteria Change	[]	Design Improvement	[X]	Environmental	[]	Facility Deactivation	[]
As-Found	[]	Facilitate Const	[]	Const. Error/Omission	[X]	Design Error/Omission	[]

13b. Justification Details

Water accumulation in certain SHMS systems from condensation requires that additional sample gas conditioning be performed in order to prevent plugging of the system.

14. Distribution (include name, MSIN, and no. of copies)

DB Engelman	L6-37 (1)	DT Lott	R3-25 (1)
LF Dougherty	T4-07 (1)	CC Scaief	S2-01 (1)
TC Schneider	L6-37 (1)	CV Vo	L6-37 (1)
DD Tate	L6-37 (1)	RE Raymond	S7-12 (1)
HW Henrikson	R3-28 (1)		
Tank Farm Information Center	R1-28 (1)		

RELEASE STAMP

A-7900-013-2 (11/94) GEE095

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1) 625234

15. Design Verification Required
[] Yes
[X] No

16. Cost Impact

	ENGINEERING		CONSTRUCTION	
Additional	[X]	$4K	[X]	$20K
Savings	[]	$	[]	$

17. Schedule Impact (days)

Improvement	[]	N/A
Delay	[]	N/A

18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

SDD/DD	[X]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Tickler File	[]
Environmental Report	[]	Inspection Plan	[]	None	[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
N/A		

20. Approvals

Signature	Date	Signature	Date
OPERATIONS AND ENGINEERING		ARCHITECT-ENGINEER	
Cog. Eng. TC Schneider		PE RL Fritz - Proj. Mgr. - RLF	8-16-96
Cog. Mgr. DB Engelman		QA	
QA HW Henrikson		Safety	
Safety		Design BD Groth BD Groth	8/15/96
Environ.		Environ.	
Other DT Lott		Other	
CC Scaief			
DD Tate			
LF Dougherty		DEPARTMENT OF ENERGY	
		Signature or a Control Number that tracks the Approval Signature	
		ADDITIONAL	

CONSTRUCTION NOTES
NOT TO BE INCORPORATED ON DRAWINGS

1. Field route galvanized rigid steel conduit above ground generally and where subject to mechanical damage, or installed in concrete pads exposed to weather. Use PVC conduit for underground runs. Install concealed conduit as directly as possible and with bend radii as long as practical.

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5. Install gas sample conditioner footings, strut, and cabinet in the approximate orientation shown as dictated by field conditions.

6. Isolate sample supply and return lines from tank and reroute sample return line to sample gas conditioning cabinet.

7. Add insulated and heat traced condensate return line from sample conditioner back to sample return line by adding one new tee and valve at the return manifold. Splice heat trace around cabinet from the supply line to the condensate return line.

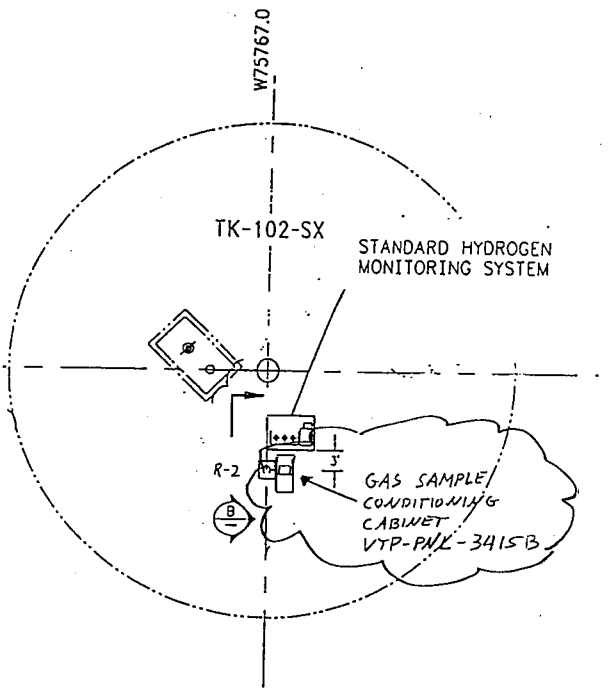
8. Seal ends of all insulated lines with heat shrink boots.

Add to Drawing H-2-87275, rev. 1, sh. 1

Add the following column to the STANDARD HYDROGEN MONITOR (SHMS) TABLE

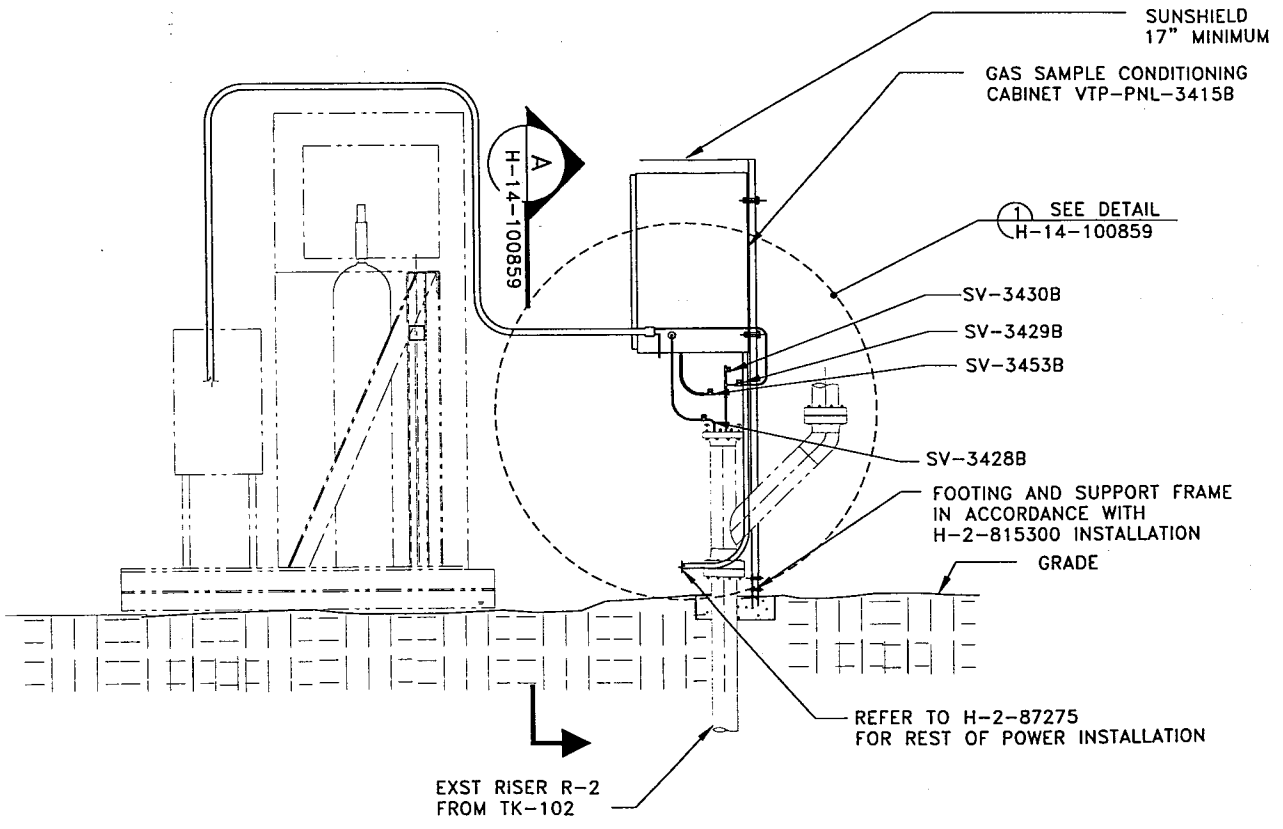
Tank Farm	Tank Number	Sample Gas Conditioner Drawings (when installed)	Sample Gas Conditioner ECNs (when installed)
A	101		
AN	103 104 105		
AW	101		
AX	101 103		
S	102 111 112		
SX	101 102 103 104 105 106 109	H-14-100859	625230, 625234
SY	101 103		
T	110		
U	103 105 107 108 109		

ARES Corporation			Engineering Change Notice Sketch		
wg. 1-2-46293 1-2-46240	Sh. 1 1	Rev. 3 4	Prepared by B.Groth	ECN No. 625234	Page 5 of 9



ECN Note Only:
Details Removed for clarity.
Maintain on Drawings.

ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-46240	1	4	ECN No. 625234	6 OF 9



EQUIPMENT INSTALLATION ELEVATION TANK 102-SX

ARES Corporation			Engineering Change Notice Sketch		
Dwg. H-2-46163 H-2-93668	Sh. 1 1	Rev. 4 1	Prepared by B.Groth	ECN No. 625234	Page 9 of 9

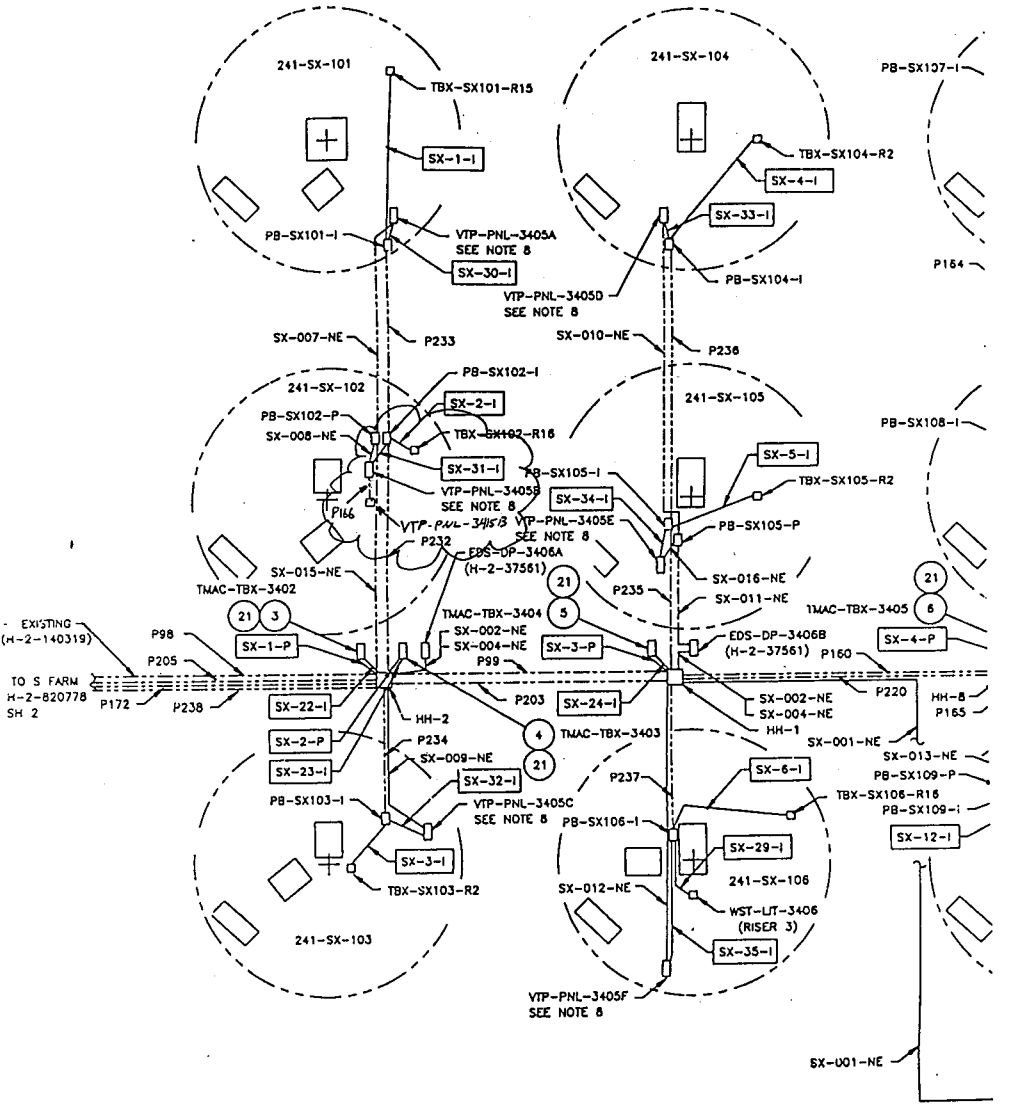
IRE UN IO	NO OF WIRES	SIZE OF WIRE	TYPE OF WIRE	FROM	VIA	TO	WIRE NUMBERS
26	3	12	4	VTP-PNL-3405B	P166	VTP-PNL-3415B	VTP-PNL-3415A-H,N,G

ARES Corporation **Engineering Change Notice Sketch**

Dwg.	Sh.	Rev.	Prepared by	ECN No.	Page
H-2-46162	1	3	B.Groth	625234	8 of 9
H-2-93668	1	1			

CONDUIT SCHEDULE		
CND NO	CND SIZE	WIRE RUN NUMBERS
P166	3/4	226

ARES Corporation		Engineering Change Notice Sketch		
Dwg. H-2-820784	Sh. 2	Rev. 2	Prepared by B.Groth	ECN No. 625234	Page 7 of 9



ENGINEERING CHANGE NOTICE Page 1 of 2

1. ECN No 625235 Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	3a. USQ Required?	4. Date
Supplemental [X] Direct Revision [] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	BD Groth, ARES Corporation, Richland, WA 946-3300	[X] Yes [] No	8/2/96
	5. Project Title/No./Work Order No. SHMS Sample Conditioning/ N2165	6. Bldg./Sys./Fac. No. 241-U	7. Approval Designator SQ
	8. Document Numbers Changed by this ECN (includes sheet no. and rev.) See Block 12	9. Related ECN No(s). See Block 12	10. Related PO No. N/A

11a. Modification Work	11b. Work Package No.	11c. Modification Work Complete	11d. Restored to Original Condition (Temp. or Standby ECN only)
[X] Yes (fill out Blk. 11b) [] No (NA Blks. 11b, 11c, 11d)		Cog. Engineer Signature & Date	N/A Cog. Engineer Signature & Date

12. Description of Change

Design Baseline Document - Yes
Engineering Task Number: ETN-94-0002

8. Document Numbers Changed by this ECN	9. Related ECN No(s).
H-2-37316, sh. 1, rev. 3	625230
H-2-37343, sh. 1, rev. 5	608113
H-2-820804, sh. 2, rev. 1	W-369-21
H-2-73692, sh. 2, rev. 2	625238
H-2-87275, sh. 1, rev. 1	

This ECN provides installation design in order to install a gas sample conditioning system on the tank 241-U-103 SHMS.

13a. Justification (mark one)

Criteria Change	[]	Design Improvement	[X]	Environmental	[]	Facility Deactivation	[]
As-Found	[]	Facilitate Const	[]	Const. Error/Omission	[X]	Design Error/Omission	[]

13b. Justification Details

Water accumulation in certain SHMS systems from condensation requires that additional sample gas conditioning be performed in order to prevent plugging of the system.

14. Distribution (include name, MSIN, and no. of copies)

DB Engelman	L6-37 (1)	DT Lott	R3-25 (1)
KJ Hull	T4-01 (1)	CC Scaief	S2-01 (1)
TC Schneider	L6-37 (1)	CV Vo	L6-37 (1)
DD Tate	L6-37 (1)	RE Raymond	S7-12 (1)
HW Henrikson	R3-28 (1)		
Tank Farm Information Center	R1-28 (1)		

RELEASE STAMP

a-7900-013-2 (11/96) GEF095

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1) 625235

15. Design Verification Required	16. Cost Impact				17. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[ ] Yes	Additional	[X] $4K	Additional	[X] $20K	Improvement	[ ] N/A
[X] No	Savings	[ ] $	Savings	[ ] $	Delay	[ ] N/A

18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

SDD/DD	[X]	Seismic/Stress Analysis	[ ]	Tank Calibration Manual	[ ]
Functional Design Criteria	[ ]	Stress/Design Report	[ ]	Health Physics Procedure	[ ]
Operating Specification	[ ]	Interface Control Drawing	[ ]	Spares Multiple Unit Listing	[ ]
Criticality Specification	[ ]	Calibration Procedure	[ ]	Test Procedures/Specification	[ ]
Conceptual Design Report	[ ]	Installation Procedure	[ ]	Component Index	[ ]
Equipment Spec.	[ ]	Maintenance Procedure	[ ]	ASME Coded Item	[ ]
Const. Spec.	[ ]	Engineering Procedure	[ ]	Human Factor Consideration	[ ]
Procurement Spec.	[ ]	Operating Instruction	[ ]	Computer Software	[ ]
Vendor Information	[ ]	Operating Procedure	[ ]	Electric Circuit Schedule	[ ]
OM Manual	[ ]	Operational Safety Requirement	[ ]	ICRS Procedure	[ ]
FSAR/SAR	[ ]	IEFD Drawing	[ ]	Process Control Manual/Plan	[ ]
Safety Equipment List	[ ]	Cell Arrangement Drawing	[ ]	Process Flow Chart	[ ]
Radiation Work Permit	[ ]	Essential Material Specification	[ ]	Purchase Requisition	[ ]
Environmental Impact Statement	[ ]	Fac. Proc. Samp. Schedule	[ ]	Tickler File	[ ]
Environmental Report	[ ]	Inspection Plan	[ ]	None	[ ]
Environmental Permit	[ ]	Inventory Adjustment Request	[ ]		[ ]

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
N/A		

20. Approvals

Signature	Date	Signature	Date
OPERATIONS AND ENGINEERING		ARCHITECT-ENGINEER	
Cog. Eng. TC Schneider		PE RL Fritz - Proj. Mgr. RL Fritz	8-16-96
Cog. Mgr. DB Engelman		QA	
QA HW Henrikson		Safety	
Safety		Design BD Groth BD Groth	8/15/96
Environ.		Environ.	
Other DT Lott		Other	
CC Scaief			
DD Tate			
KJ Hull		DEPARTMENT OF ENERGY	
		Signature or a Control Number that tracks the Approval Signature	
		ADDITIONAL	

CONSTRUCTION NOTES
NOT TO BE INCORPORATED ON DRAWINGS

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7. Add insulated and heat traced condensate return line from sample conditioner back to sample return line by adding one new tee and valve at the return manifold. Splice heat trace around cabinet from the supply line to the condensate return line.

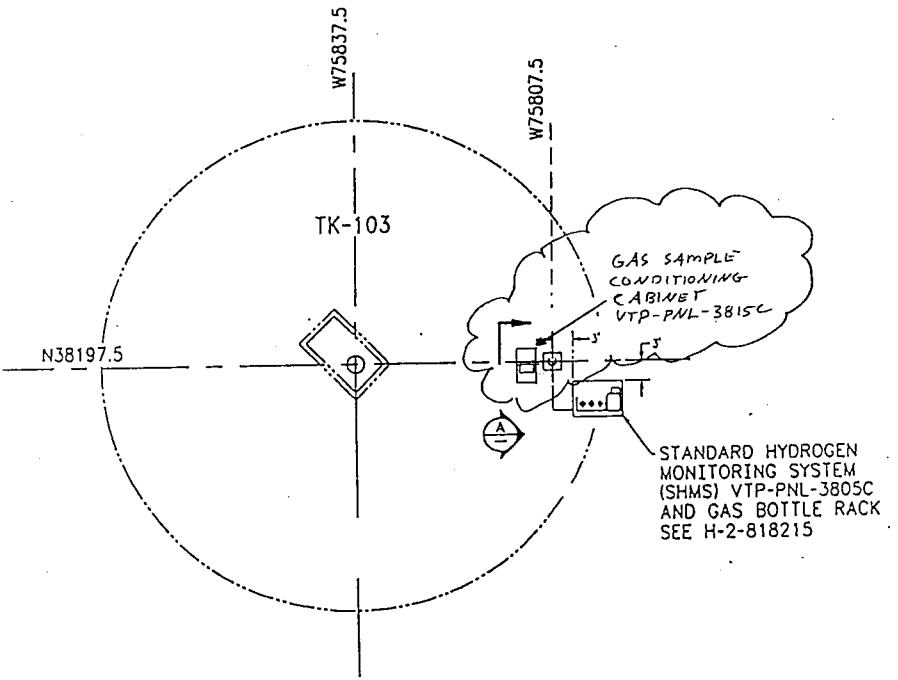
8. Seal ends of all insulated lines with heat shrink boots.

Add to Drawing H-2-87275, rev. 1, sh. 1

Add the following column to the STANDARD HYDROGEN MONITOR (SHMS) TABLE

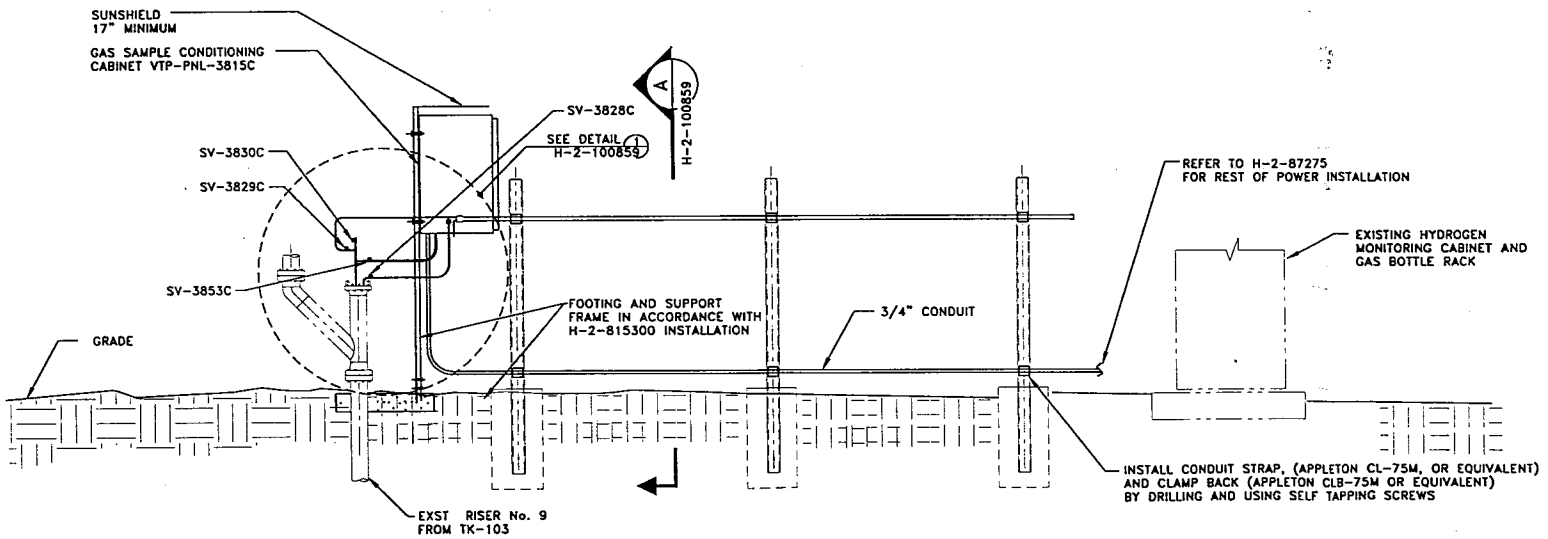
Tank Farm	Tank Number	Sample Gas Conditioner Drawing (when installed)	Sample Gas Conditioner ECNs (when installed)
A	101		
AN	103 104 105		
AW	101		
AX	101 103		
S	102 111 112		
SX	101 102 103 104 105 106 109		
SY	101 103		
T	110		
U	103 105 107 108 109	H-14-100859	625230, 625235

ARES Corporation			Engineering Change Notice Sketch		
Dwg. H-2-37316 H-2-37343	Sh. 1 1	Rev. 3 5	Prepared by B.Groth	ECN No. 625235	Page 5 of 9



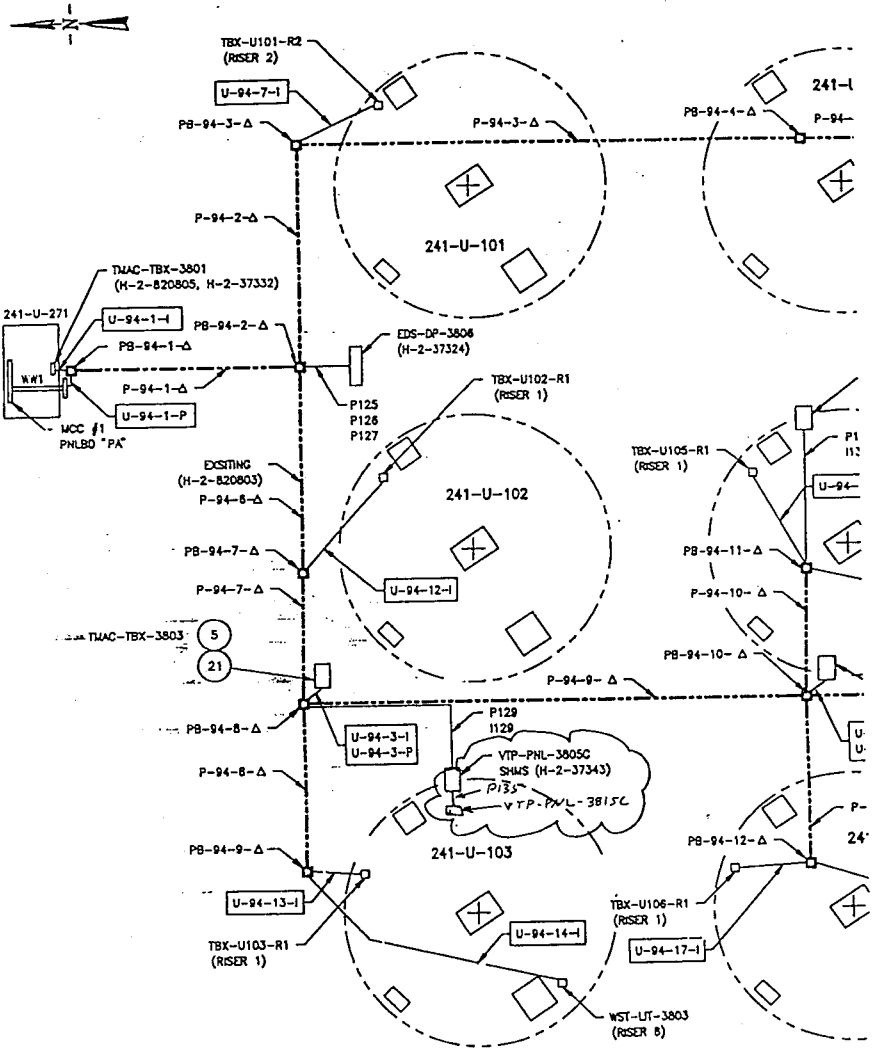
ECN Note Only: Detail Removed for Clarity. Maintain on Drawing

ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-37343	1	5	ECN No. 625235	6 OF 9



EQUIPMENT INSTALLATION ELEVATION TANK 103-U

ARES Corporation			Engineering Change Notice Sketch		
Dwg. I-2-820804	Sh. 2	Rev. 1	Prepared by B.Groth	ECN No. 625235	Page 7 of 9



ARES Corporation			Engineering Change Notice Sketch		
Dwg. H-2-73692	Sh. 2	Rev. 2	Prepared by B.Groth	ECN No. 625235	Page 8 of 9

CONDUIT SCHEDULE		
CND NO	CND SIZE	WIRE RUN NUMBERS
P135	3/4	199

Dwg.	Sh.	Rev.	Prepared by	ECN No.	Page
H-2-73692	2	2	B.Groth	625235	9 of 9

RE JN O	NO OF WIRES	SIZE OF WIRE	TYPE OF WIRE	FROM	VIA	TO	WIRE NUMBERS
99	3	12	2	VTP-PNL-3805C	P135	VTP-PNL-3815C	VTP-PNL-3815C-H,N,G

ENGINEERING CHANGE NOTICE Page 1 of 14

1. ECN № 625236 Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	3a. USQ Required?	4. Date
Supplemental [X] Direct Revision [] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	BD Groth, ARES Corporation, Richland, WA 946-3300	[X] Yes [] No	8/2/96
	5. Project Title/No./Work Order No. SHMS Sample Conditioning/ N2165	6. Bldg./Sys./Fac. No. 241 General	7. Approval Designator SQ
	8. Document Numbers Changed by this ECN (includes sheet no. and rev.) See Block 12	9. Related ECN No(s). See Block 12	10. Related PO No. N/A

11a. Modification Work	11b. Work Package No.	11c. Modification Work Complete	11d. Restored to Original Condition (Temp. or Standby ECN only)
[X] Yes (fill out Blk. 11b) [] No (NA Blks. 11b, 11c, 11d)		Cog. Engineer Signature & Date	N/A Cog. Engineer Signature & Date

12. Description of Change

Design Baseline Document - No
Engineering Task Number: ETN-94-0002

8. Document Numbers Changed by this ECN	9. Related ECN No(s).
H-2-822773, sh. 1, rev. 1	625237
H-2-822774, sh. 1, rev. 0	625238
H-2-822775, sh. 1, rev. 1	W-369-55
H-2-822775, sh. 5, rev. 0	
H-2-822776, sh. 1, rev. 0	
H-2-822782, sh. 1, rev. 1	
H-2-822782, sh. 2, rev. 1	
H-2-822780, sh. 1, rev. 0	

This ECN provides changes to the SHMS-C in order to install a gas sample conditioning

13a. Justification (mark one)

Criteria Change	[]	Design Improvement	[X]	Environmental	[]	Facility Deactivation	[]
As-Found	[]	Facilitate Const	[]	Const. Error/Omission	[X]	Design Error/Omission	[]

13b. Justification Details

Water accumulation in certain SHMS systems from condensation requires that additional sample gas conditioning be performed in order to prevent plugging of the system.

14. Distribution (include name, MSIN, and no. of copies)

DB Engelman	L6-37 (1)	DT Lott	R3-25 (1)
JM Jones	S5-13 (1)	CC Scaief	S2-01 (1)
TC Schneider	L6-37 (1)	CV Vo	L6-37 (1)
DD Tate	L6-37 (1)	RE Raymond	S7-12 (1)
HW Henrikson	R3-28 (1)		
Tank Farm Information Center	R1-28 (1)		

RELEASE STAMP

A-7900-013-2 (11/94) GEF095

A-7900-013-1

ENGINEERING CHANGE NOTICE

1. ECN (Use no. from pg. 1) 625236

15. Design Verification Required	16. Cost Impact				17. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[ ] Yes	Additional	[ ] $ N/A	Additional	[ ] $ N/A	Improvement	[ ] N/A
[X] No	Savings	[ ] $	Savings	[ ] $	Delay	[ ] N/A

18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

SDD/DD	[X]	Seismic/Stress Analysis	[ ]	Tank Calibration Manual	[ ]
Functional Design Criteria	[ ]	Stress/Design Report	[ ]	Health Physics Procedure	[ ]
Operating Specification	[ ]	Interface Control Drawing	[ ]	Spares Multiple Unit Listing	[ ]
Criticality Specification	[ ]	Calibration Procedure	[ ]	Test Procedures/Specification	[ ]
Conceptual Design Report	[ ]	Installation Procedure	[ ]	Component Index	[ ]
Equipment Spec.	[ ]	Maintenance Procedure	[ ]	ASME Coded Item	[ ]
Const. Spec.	[ ]	Engineering Procedure	[ ]	Human Factor Consideration	[ ]
Procurement Spec.	[ ]	Operating Instruction	[ ]	Computer Software	[ ]
Vendor Information	[ ]	Operating Procedure	[ ]	Electric Circuit Schedule	[ ]
OM Manual	[ ]	Operational Safety Requirement	[ ]	ICRS Procedure	[ ]
FSAR/SAR	[ ]	IEFD Drawing	[ ]	Process Control Manual/Plan	[ ]
Safety Equipment List	[ ]	Cell Arrangement Drawing	[ ]	Process Flow Chart	[ ]
Radiation Work Permit	[ ]	Essential Material Specification	[ ]	Purchase Requisition	[ ]
Environmental Impact Statement	[ ]	Fac. Proc. Samp. Schedule	[ ]	Tickler File	[ ]
Environmental Report	[ ]	Inspection Plan	[ ]	None	[ ]
Environmental Permit	[ ]	Inventory Adjustment Request	[ ]		[ ]

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
N/A		

20. Approvals

Signature	Date	Signature	Date
OPERATIONS AND ENGINEERING		ARCHITECT-ENGINEER	
Cog. Eng. TC Schneider		~~PE~~ RL Fritz Proj. Mgr. RL Fritz	8-16-96
Cog. Mgr. DB Engelman		QA	
QA HW Henrikson		Safety	
Safety		Design BD Groth BD Groth	8/15/96
Environ.		Environ.	
Other DT Lott		Other	
CC Scaief			
DD Tate			
		DEPARTMENT OF ENERGY	
		Signature or a Control Number that tracks the Approval Signature	
		ADDITIONAL	

CONSTRUCTION NOTES
NOT TO BE INCORPORATED ON DRAWINGS

1. Conductor shall be stranded copper with type THHN/THWN insulation of type and size indicated on attached pages.

2. Use galvanized rigid steel conduit above ground generally and where subject to mechanical damage, or installed in concrete pads exposed to weather. Use PVC conduit for underground runs. Install concealed conduit as directly as possible and with bend radii as long as practical.

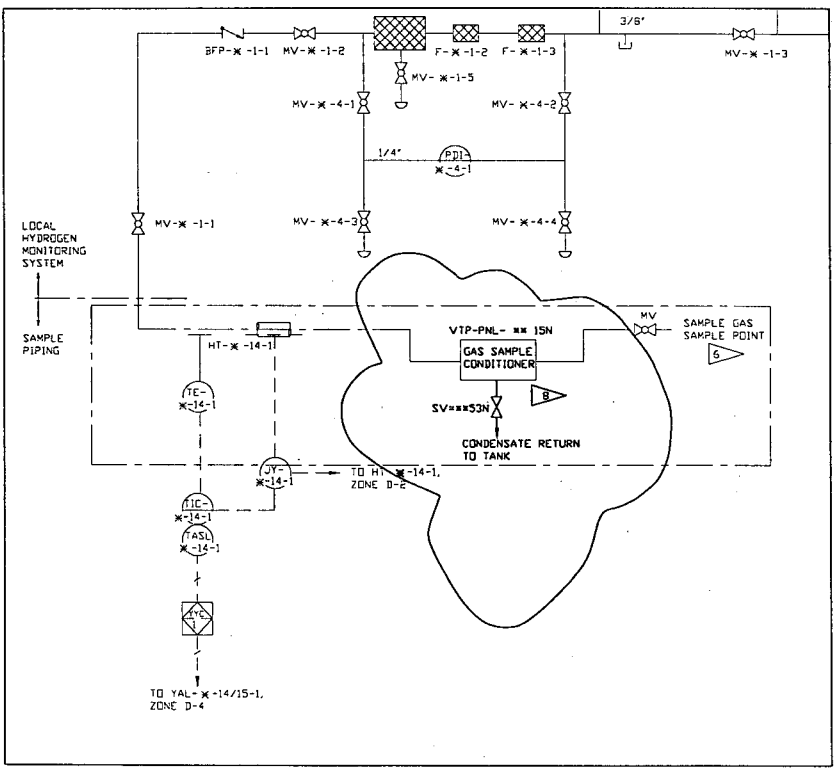
3. Install boxes firmly in position and plumb. Install dust covers on junction, pull boxes and other types of wiring outlets at installation. Replace with permanent covers or devices after wires are installed.

4. Do not bend cables installed in wireways to where the bend radii is less than ten times the cable diameter. Bind power conductors with cable ties at 18 inch intervals (maximum). Identify conductors by wire numbers shown on the drawings with wiremarkers.

5. Wiring shall be tested for continuity and isolation from ground prior to energizing.

6. It may be necessary to add additional terminal block mounting rail (p/n 104 on H-2-822775, sh. 5, rev. 0) in order to install additional breaker and terminal blocks.

ARES Corporation			ENGINEERING CHANGE NOTICE SKETCH	
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-822773	1	1	ECN No. 625236	4 OF 14



(STANDARD HYDROGEN MONITORING SYSTEM)

ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-822773	1	1	ECN No. 625236	5 OF 14

GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

1. EQUIPMENT AND INSTRUMENTATION IDENTIFIERS PER H-2-99091, FLOW DIAGRAM IDENTIFICATION SCHEDULE.

2. USER-DEFINED ITEMS ARE AS FOLLOWS:
   - YAH - ALARM HORN
   - YAL - ALARM LIGHT
   - EB - INTRINSIC SAFETY BARRIER
   - BY - INTERPOSING RELAY

3. AREAS WITHIN PHANTOM LINES DENOTE COMPONENTS OUTSIDE CABINET.

4. DEVICES SO NOTED ARE INTRINSIC SAFETY APPARATUS.

5. EQUIPMENT AND INSTRUMENT DESIGNATOR DEFINITION:

   A B C D
   \ \ | /

   EXAMPLE: DPI-**-1-1

   A. EQUIPMENT/INSTRUMENT IDENTIFIER PER H-2-99091.

      1 2 3
      \ \ \

   B. EXAMPLE: 01 J SY
      1. LAST TWO DIGITS OF THE TANK NUMBER (101).
      2. TANK HYDROGEN MONITOR SEQUENTIAL IDENTIFIER (J THROUGH N).
      3. TANK FARM IDENTIFIER.

   C. SEQUENTIAL LOOP IDENTIFIER.
   D. SEQUENTIAL LOOP PART IDENTIFIER.

6. SEE THE REFERENCE DRAWING TABLE ON H-2-87275 FOR SAMPLE/RETURN POINT LOCATION.

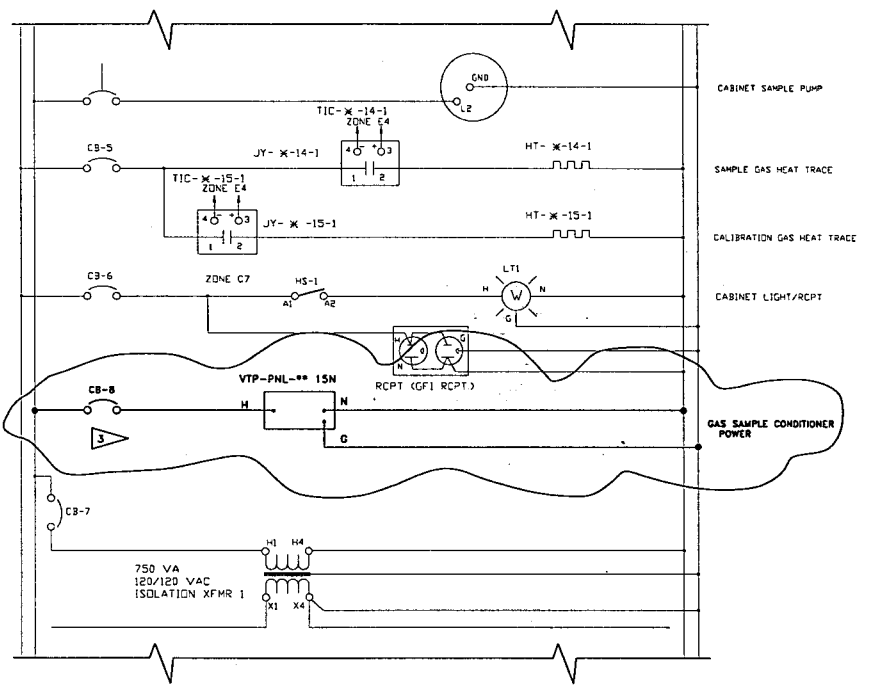
8. VTP-PNL- ** 15N MAY BE ADDED BY ECN AS NECESSARY FOR MOISTURE REMOVAL. SEE H-2-87275 TO DETERMINE LOCATIONS INSTALLED.

   ** IS THE FARM NUMBER (A=8, AX=9, C=13, S=33, SX=34, U=38 ETC.), AND "N" IS THE TANK NUMBER (101=A, 102=B, ETC).

(STANDARD HYDROGEN MONITORING SYSTEM)

ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-822774	1	0	ECN No. 625236	6 OF 14

ELEMENTARY DIAGRAM

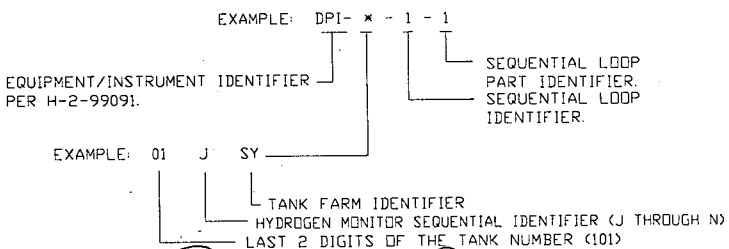


(STANDARD HYDROGEN MONITORING SYSTEM)

ARES Corporation			ENGINEERING CHANGE NOTICE SKETCH	
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-822774	1	0	ECN No. 625236	7 OF 14

GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

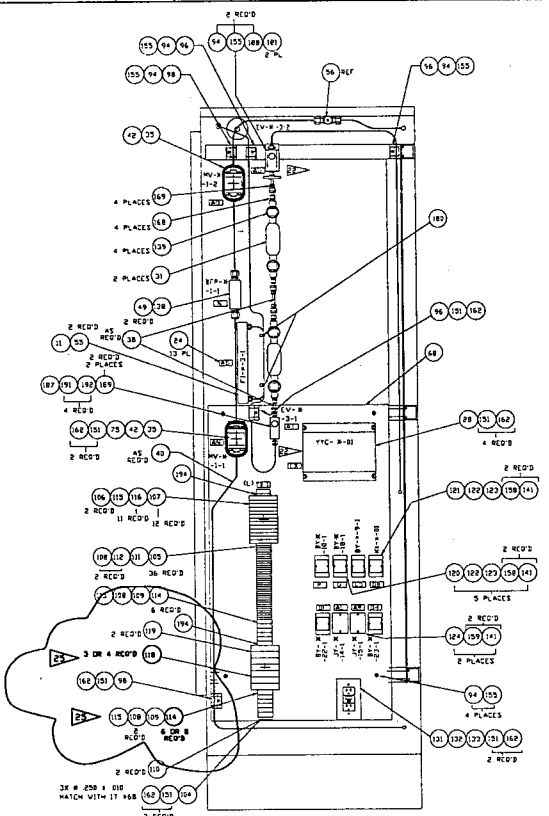
1. ALL RELAY CONTACTS ARE SHOWN IN THE DEENERGIZED SHELF CONDITION.
2. ALL PROCESS ELEMENT DESIGNATORS ARE DEFINED BY FOLLOWING:



3. CB-8 IS ONLY INCLUDED ON SYSTEMS WHERE VTP-PNL-** 15N, SAMPLE GAS CONDITIONER IS INSTALLED SEE H-2-87275 FOR INSTALLED LOCATIONS.
4. NUMBERING SYSTEM FOR VTP-PNL-** 15N IS AS FOLLOWS: ** IS THE TANK FARM IDENTIFIER (A=8, AX=9, C=13, S=33, SX=34, U=38) AND "N" IS THE TANK IDENTIFIER (101=A, 102=8, ETC.).

(STANDARD HYDROGEN MONITORING SYSTEM)

ARES Corporation			ENGINEERING CHANGE NOTICE SKETCH	
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-822775	5	0	ECN No. 625236	8 OF 14



SECTION A-A (SH 3-A6)

(STANDARD HYDROGEN MONITORING SYSTEM)

ARES Corporation			ENGINEERING CHANGE NOTICE SKETCH	
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-822775	1	1	ECN No. 625236	9 OF 14

16> SEE INSTALLATION DRAWING H-2-87281 FOR INSTALLATION REQUIREMENTS. APPLICABLE DETAIL IS SHOWN ON THIS DRAWING.

17. PROVIDE CERTIFICATION OF TESTING 100% OF INSTALLED WIRING AS VERIFIED BY THE PERFORMING CRAFT. TEST WIRING FOR CONTINUITY (MAXIMUM 1 OHM) AND UNINTENTIONAL SHORTS (MINIMUM 200 MEGOHMS) WITH CALIBRATED TEST INSTRUMENTS CERTIFIED TRACEABLE TO NIST STANDARDS. REPAIR ALL VARIANCES.

18. PROVIDE CERTIFICATION OF PRESSURE LEAK TESTING OF ALL INSTALLED GAS TUBING WITH NITROGEN TO 30 ±2 PSIG IN ACCORDANCE WITH ASME B31.1 PARAGRAPH 137.5. ISOLATE INSTRUMENTATION THAT MIGHT BE DAMAGED BY THE TEST PRESSURE. REPAIR ALL LEAKS.

19> THE DIFFERENTIAL PRESSURE GAUGE SHALL BE ORDERED WITH A VITON DIAPHRAGM AND TEFLON COATED RANGE SPRING AND CERAMIC MAGNET.

20> THE FLOW METER SHALL BE ORDERED WITH CALIBRATION CERTIFICATION.

21> THE WHITTAKER ELECTRO-CHEMICAL CELLS SHALL BE ORDERED WITH CALIBRATION CERTIFICATION.

22> INSTALL THE ASCO SOLENOID VALVES WITH THE "1" FACING DOWN AND THE "2" FACING UP.

23> STRAIN RELIEF TUBING TO BE FIELD ROUTED.

25> **P/N 118 4 REQUIRED, AND P/N 114 8 REQUIRED ON SYSTEMS WHERE VTP-PNL-** 15N IS INSTALLED.**

(STANDARD HYDROGEN MONITORING SYSTEM)

ARES Corporation			ENGINEERING CHANGE NOTICE SKETCH	
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-822776	1	0	ECN No. 625236	10 OF 14

GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

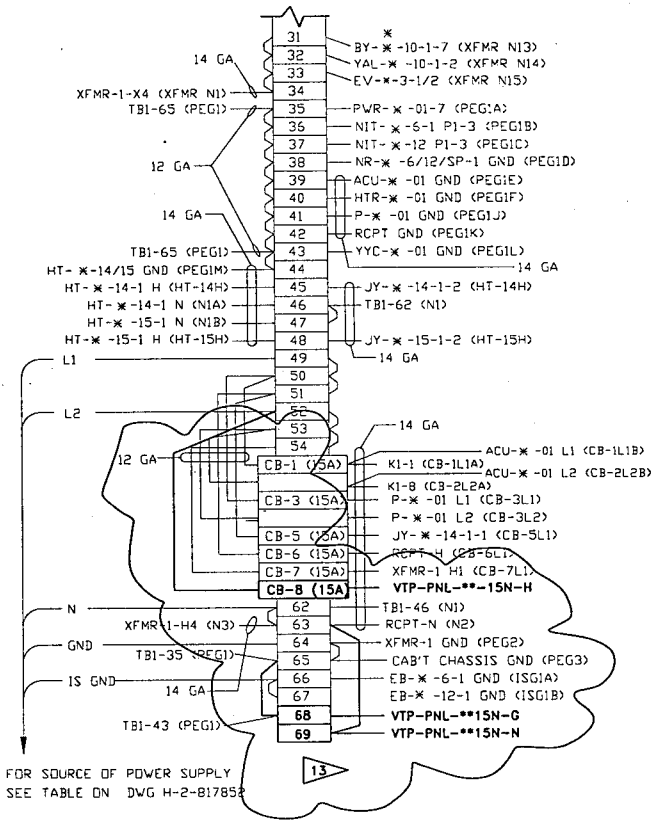
11. INSTALLATION SHALL CONFORM TO THE NEC-1993 EDITION.

12. PROVIDE CERTIFICATION OF TESTING 100% OF INSTALLED WIRING AS VERIFIED BY THE PERFORMING CRAFT. TEST WIRING FOR CONTINUITY (MAXIMUM 1 OHM) AND UNINTENTIONAL SHORTS (MINIMUM 200 MEGOHMS) WITH CALIBRATED TEST INSTRUMENTS CERTIFIED TRACEABLE TO NIST STANDARD. REPAIR ALL VARIANCES.

13. CB-8 AND TERMINAL BLOCKS 68 & 69 ARE ONLY INCLUDED ON SYSTEMS WHERE VTP-PNL-**15N IS INSTALLED.
SEE H-2-87275.
** IS THE TANK FARM IDENTIFIER (A=8, AX=9, C=13, S=33, SX=34, U=38) AND "N" IS THE TANK IDENTIFIER (101=A, 102=B, ETC.)

(STANDARD HYDROGEN MONITORING SYSTEM)

ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-822776	1	0	ECN No. 625236	11 OF 14

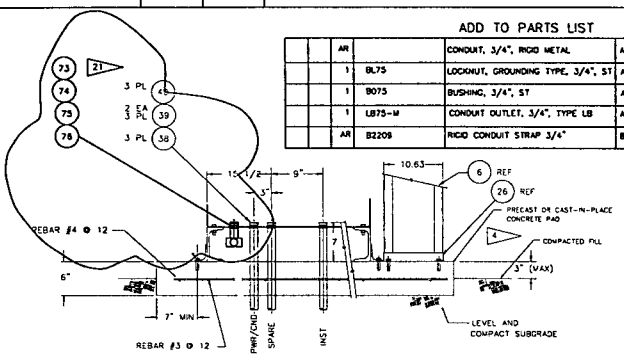


(STANDARD HYDROGEN MONITORING SYSTEM)

ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-822782	1	1	ECN No. 625236	12 OF 14

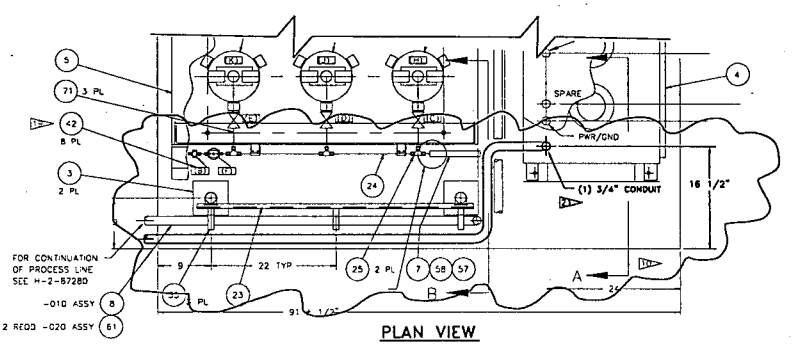
ADD TO PARTS LIST

		AR		CONDUIT, 3/4", RIGID METAL	ANY GRADE		73
		1	BL75	LOCKNUT, GROUNDING TYPE, 3/4", ST	APPLETON		74
		1	B075	BUSHING, 3/4", ST	APPLETON		75
		1	LB75-M	CONDUIT OUTLET, 3/4", TYPE LB	APPLETON		76
		AR	B2208	RIGID CONDUIT STRAP 3/4"	B-LINE		77



VIEW A-A -- SLAB PENETRATION & ANCHOR DETAIL

SCALE: 1/4" = 1"



PLAN VIEW

1 EQUIPMENT ARRANGEMENT W/ONE DUAL PROCESS LINE
SCALE: 1/8" = 1

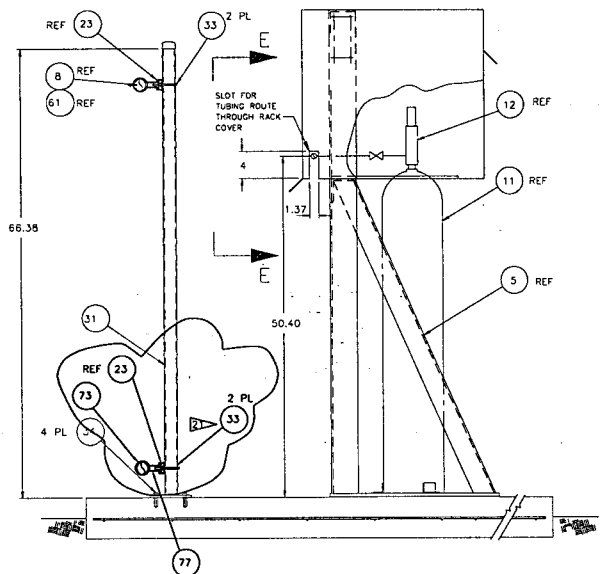
2 EQUIPMENT ARRANGEMENT W/TWO SINGLE PROCESS LINES
SCALE: 1/8" = 1

ADD GENERAL NOTE (21):

21 ONLY ON SYSTEMS WHERE THE GAS SAMPLE CONDITIONING CABINET IS INSTALLED.

(STANDARD HYDROGEN MONITORING SYSTEM)

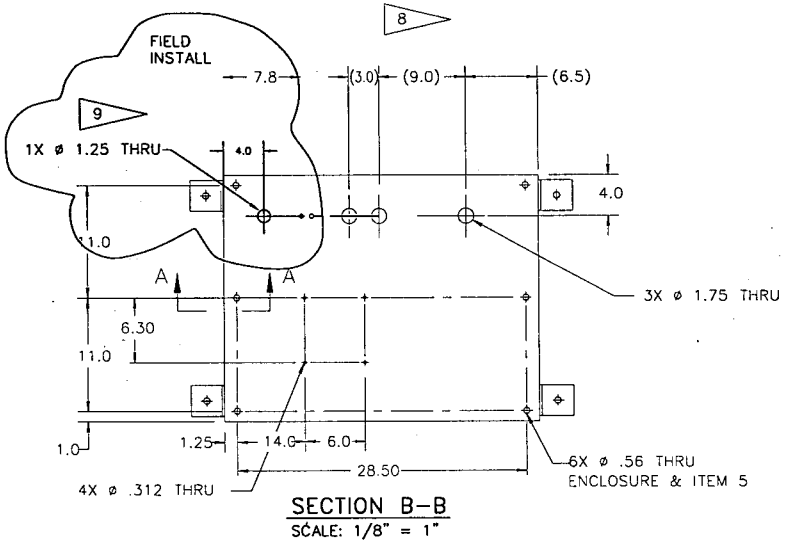
ARES Corporation			ENGINEERING CHANGE NOTICE SKETCH	
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-822782	2	1	ECN No. 625236	13 OF 14



VIEW B-B

(STANDARD HYDROGEN MONITORING SYSTEM)

ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-822780	1	0	ECN No. 625236	14 OF 14



SECTION B–B
SCALE: 1/8" = 1"

ADD GENERAL NOTE (9):

9. ONLY ON SYSTEMS WHERE GAS SAMPLE CONDITIONING CABINET IS INSTALLED.

(STANDARD HYDROGEN MONITORING SYSTEM)

ENGINEERING CHANGE NOTICE

Page 1 of 10

1. ECN No 625237

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	3a. USQ Required?	4. Date
Supplemental [] Direct Revision [] Change ECN [X] Temporary [] Standby [] Supersedure [] Cancel/Void []	BD Groth, ARES Corporation, Richland, WA 946-3300	[X] Yes [] No	8/2/96
	5. Project Title/No./Work Order No. SHMS Sample Conditioning/ N2165	6. Bldg./Sys./Fac. No. 241-C	7. Approval Designator SQ
	8. Document Numbers Changed by this ECN (includes sheet no. and rev.) See Block 12	9. Related ECN No(s). See Block 12	10. Related PO No. N/A

11a. Modification Work	11b. Work Package No.	11c. Modification Work Complete	11d. Restored to Original Condition (Temp. or Standby ECN only)
[X] Yes (fill out Blk. 11b) [] No (NA Blks. 11b, 11c, 11d)		Cog. Engineer Signature & Date	N/A Cog. Engineer Signature & Date

12. Description of Change

Design Baseline Document - Yes
Engineering Task Number: ETN-94-0002

8. Document Numbers Changed by this ECN	9. Related ECN No(s).
W-369-55	
H-2-73957, sh. 1, rev. 1	625236
H-2-73960, sh. 1, rev. 1	625238
H-2-73960, sh. 2, rev. 1	
H-2-818569, sh. 1, rev. 0	
H-2-818470, sh. 3, rev. 0	

This Change ECN to ECN W-369-55 provides installation design in order to install a gas sample conditioning system on the tank 241-C-106 SHMS.

13a. Justification (mark one)

Criteria Change	[]	Design Improvement	[X]	Environmental	[]	Facility Deactivation	[]
As-Found	[]	Facilitate Const	[]	Const. Error/Omission	[X]	Design Error/Omission	[]

13b. Justification Details

Water accumulation in certain SHMS systems from condensation requires that additional sample gas conditioning be performed in order to prevent plugging of the system.

14. Distribution (include name, MSIN, and no. of copies)

DB Engelman	L6-37 (1)	DT Lott	R3-25 (1)
JM Jones	S5-13 (1)	CC Scaief	S2-01 (1)
TC Schneider	L6-37 (1)	CV Vo	L6-37 (1)
DD Tate	L6-37 (1)	RE Raymond	S7-12 (1)
HW Henrikson	R3-28 (1)		
Tank Farm Information Center	R1-28 (1)		

RELEASE STAMP

A-7900-013-2 (11/96) GEF095

ENGINEERING CHANGE NOTICE

625237

15. Design Verification Required	16. Cost Impact				17. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[] Yes	Additional	[X] $4K	Additional	[X] $20K	Improvement	[] N/A
[X] No	Savings	[] $	Savings	[] $	Delay	[] N/A

18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Tickler File	[]
Environmental Report	[]	Inspection Plan	[]	None	[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
N/A		

20. Approvals

Signature	Date	Signature	Date
OPERATIONS AND ENGINEERING		ARCHITECT-ENGINEER	
Cog. Eng. TC Schneider		~~PE~~ RL Fritz Proj Mgr RL Fritz	8/16/96
Cog. Mgr. DB Engelman		QA	
QA HW Henrikson		Safety	
Safety		Design BD Groth BD Groth	8/16/96
Environ.		Environ.	
Other DT Lott		Other	
CC Scaief			
DD Tate			
JM Jones		DEPARTMENT OF ENERGY	
		Signature or a Control Number that tracks the Approval Signature	
		ADDITIONAL	

This ECN changes ECN W-369-55 to install a gas sample conditioning cabinet in the SHMS Gas Sample Lines to remove moisture from the gas stream prior to entering the SHMS.

Change page 5 of ECN W-369-5 to add the following Electrical Construction Note

22. For installation of the Gas Sample Conditioner power supply it may be necessary to add additional terminal block mounting rail (p/n 104 on H-2-822775, sh. 5, rev. 0) in order to install additional breaker and terminal blocks as described in ECN 625236.

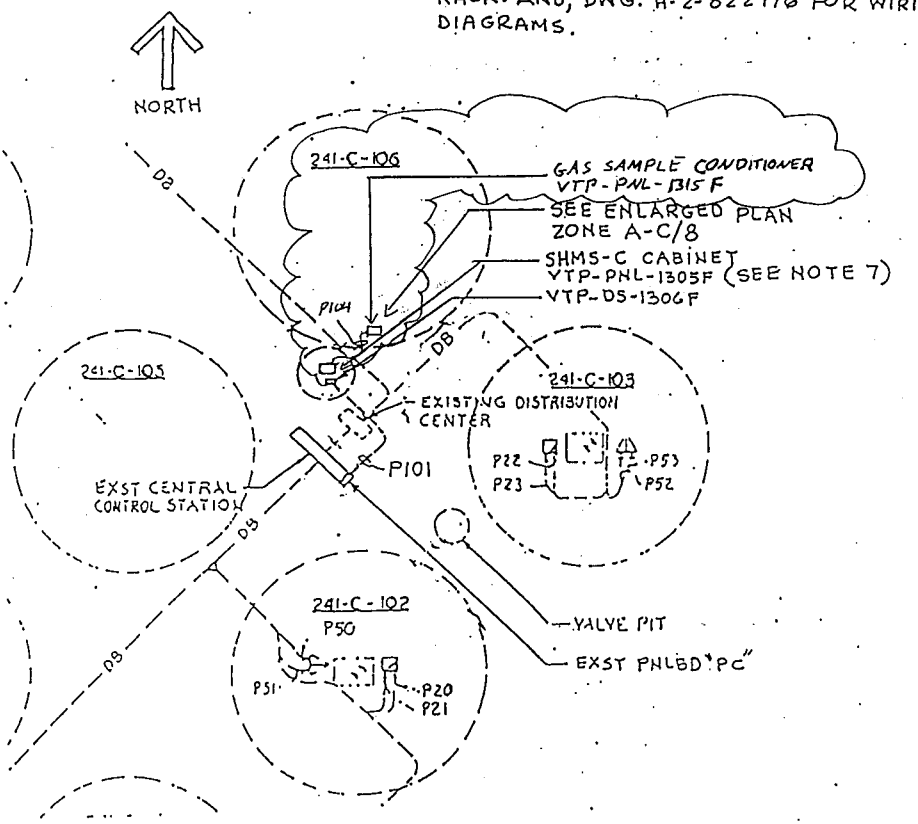
ARES Corporation			Engineering Change Notice Sketch		
Dwg. H-2-73957	Sh. 1	Rev. 1	Prepared by BD Groth	ECN No. 625237	Page 4 of 10

Change page 7 of ECN W-369-55 as shown in clouded area to add above ground conduit run P104

ZONE B/1-3

ZONE D/9 :

NOTE 7. SEE DWG. H-2-822775 FOR HYDROGEN MONITORING CABINET AND GAS BOTTLE RACK. AND, DWG. H-2-822776 FOR WIRING DIAGRAMS.



Dwg.	Sh.	Rev.	Prepared by	ECN No.	Page
H-2-73960	1,2	1	BD Groth	625237	5 of 10

Change page 10 of ECN W-369-55 to include the clouded areas below

Sh. 1 Zone B/11-12

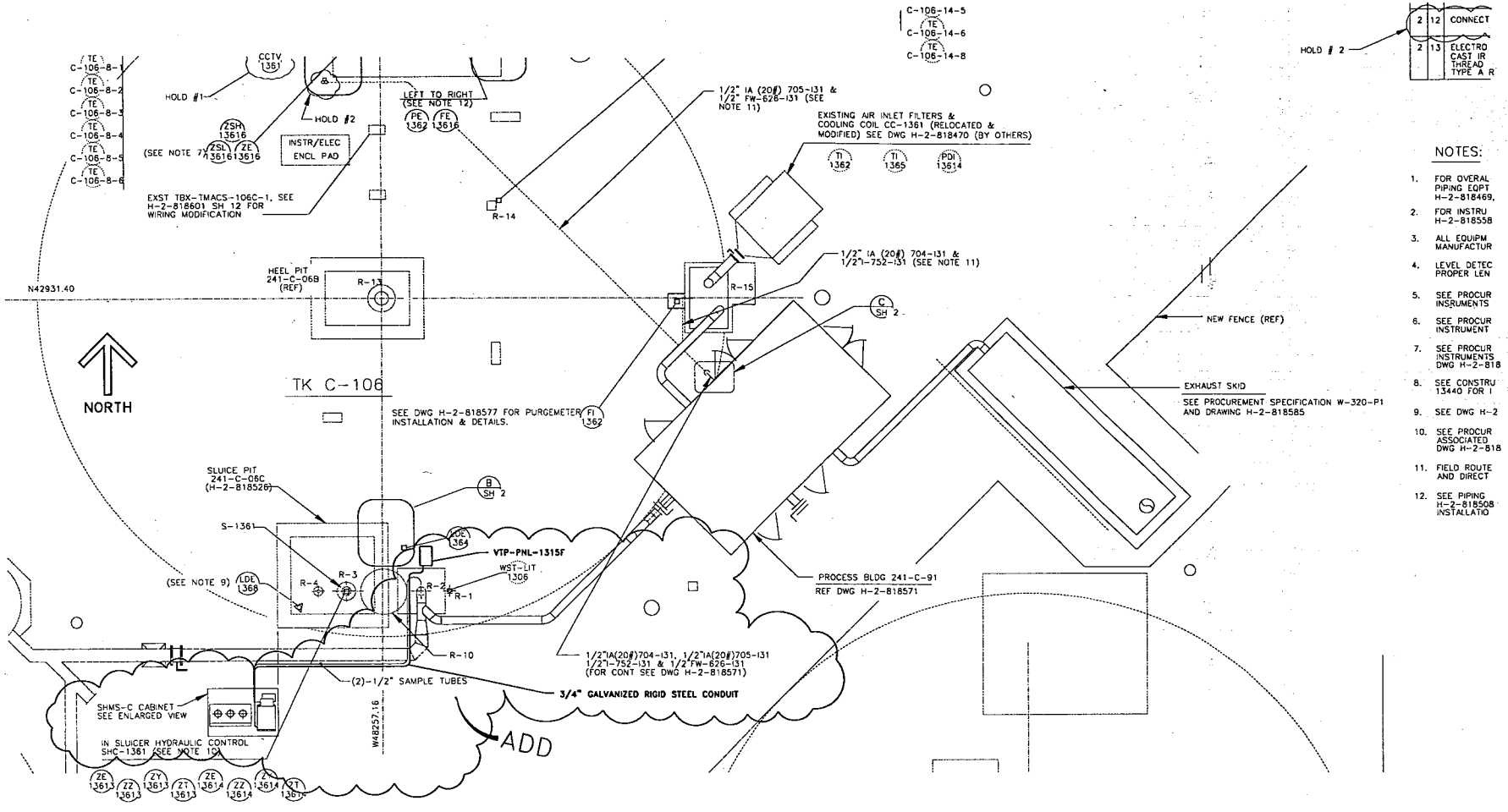
CONDUIT SCHEDULE		
CND NO	CND SIZE	WIRE RUN NUMBERS
P104	3/4	184

Sh. 2 zone C/1-10

WIRE RUN NO	NO OF WIRES	SIZE OF WIRE	TYPE OF WIRE	FROM	VIA	TO	WIRE NUMBERS
184	3	12	2	VTP-PNL-1305A	P104	VTP-PNL-1315A	VTP-PNL-1315A-H,N,G

ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-818569	1	0	ECN No. 625236	6 OF 10

CHANGE ECN W-369-55, PAGE 11 OF 15
AS FOLLOWS:



PLAN
(SEE NOTE 1)

NOTES:

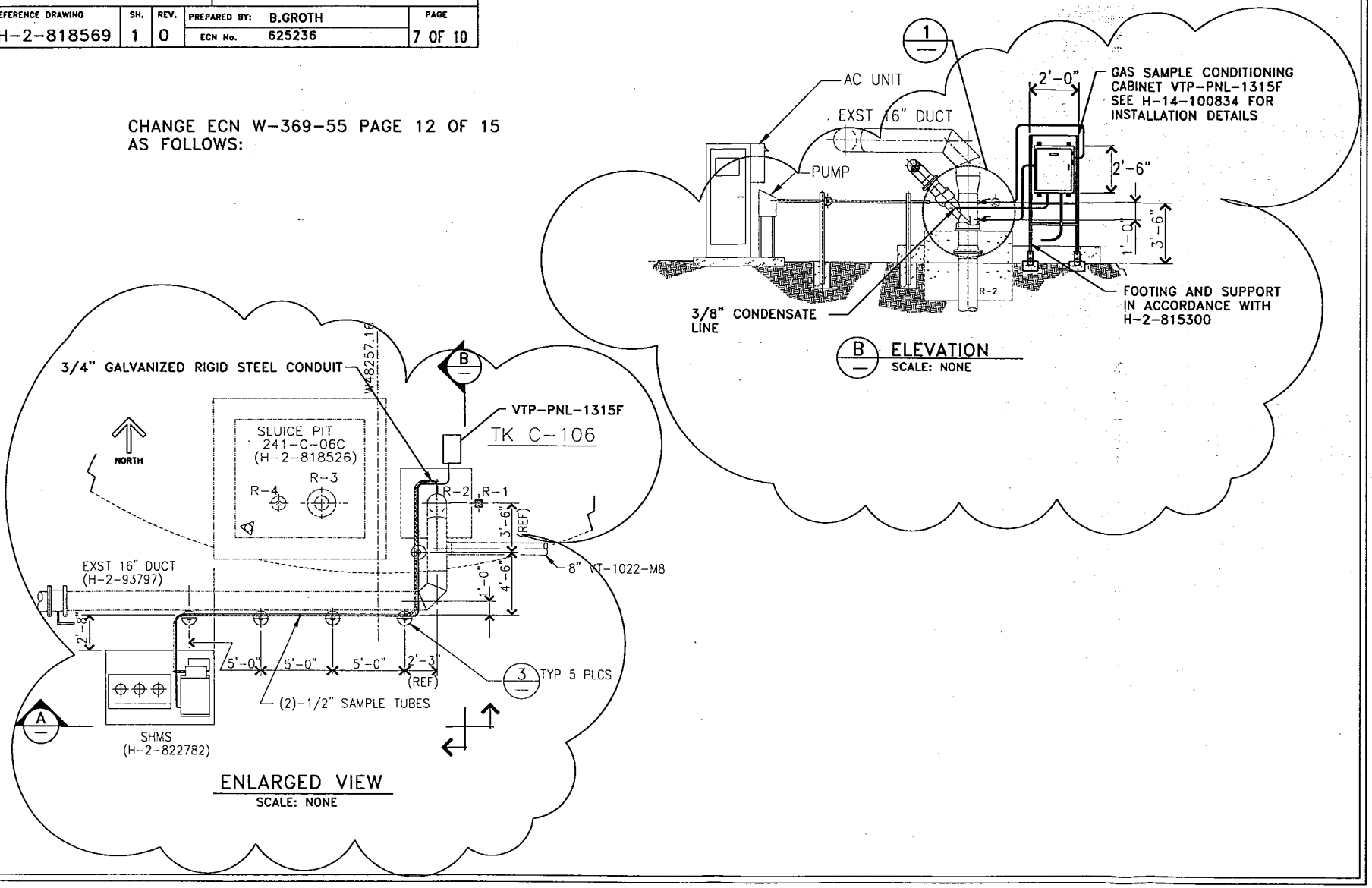
1. FOR OVERAL PIPING EQPT H-2-818469,
2. FOR INSTRU H-2-818558
3. ALL EQUIPM MANUFACTUR
4. LEVEL DETEC PROPER LEN
5. SEE PROCUR INSRUMENTS
6. SEE PROCUR INSTRUMENT
7. SEE PROCUR INSTRUMENTS DWG H-2-818
8. SEE CONSTRU 13440 FOR I
9. SEE DWG H-2
10. SEE PROCUR ASSOCIATED DWG H-2-818
11. FIELD ROUTE AND DIRECT
12. SEE PIPING H-2-818508 INSTALLATIO

H-2-818423 DRAWING LIST SH 7

CAD FILE: E369-55G REV2

ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-818569	1	0	ECN No. 625236	7 OF 10

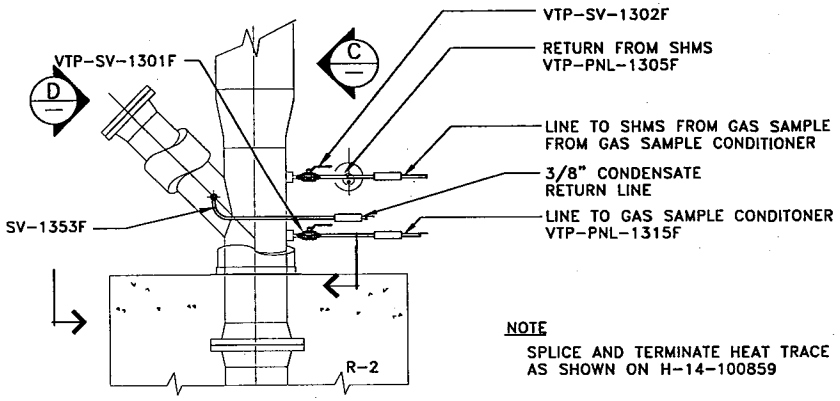
CHANGE ECN W-369-55 PAGE 12 OF 15
AS FOLLOWS:



ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-818569	1	0	ECN No. 625236	8 OF 10

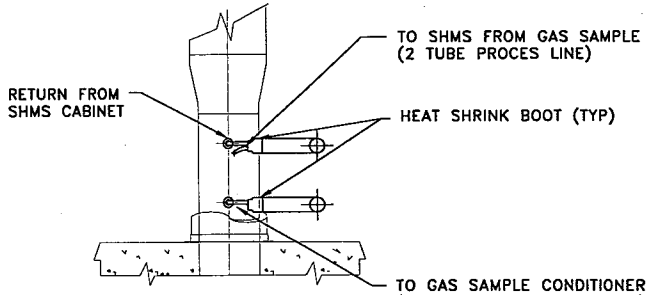
CHANGES ECN W-369-55, PAGE 13 OF 15
AS FOLLOWS:

NOTE: EXISTING DETAILS REMOVED FOR CLARITY

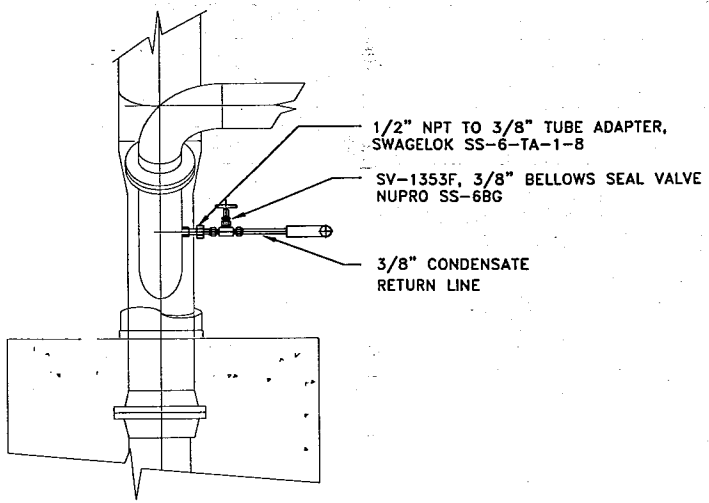


NOTE
SPLICE AND TERMINATE HEAT TRACE
AS SHOWN ON H-14-100859

1 DETAIL



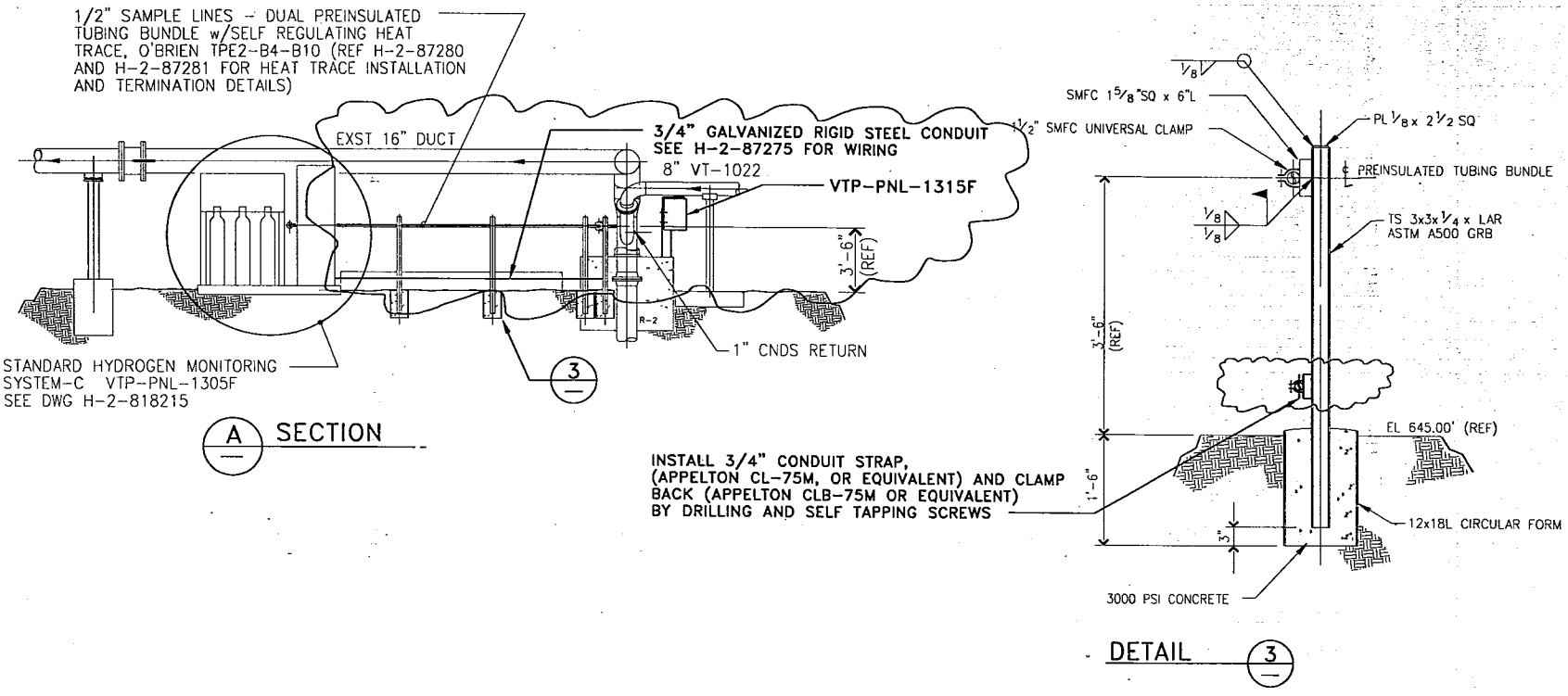
ELEVATION C
SCALE: NONE



ELEVATION D
SCALE: NONE

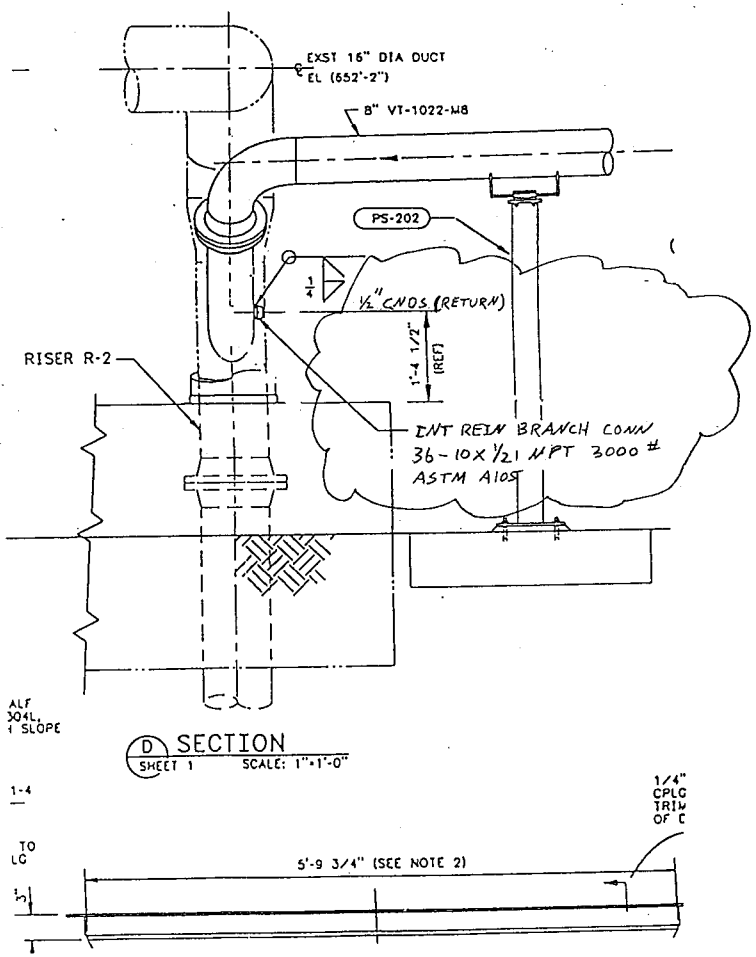
ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-818569	1	0	ECN No. 625236	9 OF 10

CHANGES ECN W-369-55, PAGE 14 OF 15
AS FOLLOWS:



ARES Corporation			Engineering Change Notice Sketch		
Dwg. H-2-818470	Sh. 3	Rev. 0	Prepared by BD Groth	ECN No. 625237	Page 10 of 10

Change page 15 of ECN W-369-55 as shown in clouded area to change condensate return port from 1" to 1/2"



ENGINEERING CHANGE NOTICE

Page 1 of 4

1. ECN No 625238

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	3a. USQ Required?	4. Date
Supplemental [X] Direct Revision [] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	BD Groth, ARES Corporation, Richland, WA 946-3300	[X] Yes [] No	8/2/96
	5. Project Title/No./Work Order No. SHMS Sample Conditioning/ N2165	6. Bldg./Sys./Fac. No. 241-General	7. Approval Designator SQ
	8. Document Numbers Changed by this ECN (includes sheet no. and rev.) See Block 12	9. Related ECN No(s). See Block 12	10. Related PO No. N/A

11a. Modification Work	11b. Work Package No.	11c. Modification Work Complete	11d. Restored to Original Condition (Temp. or Standby ECN only)
[X] Yes (fill out Blk. 11b) [] No (NA Blks. 11b, 11c, 11d)		Cog. Engineer Signature & Date	N/A Cog. Engineer Signature & Date

12. Description of Change

Design Baseline Document - Yes
Engineering Task Number: ETN-94-0002

8. Document Numbers Changed by this ECN
H-2-85268, sh. 1, rev. 0

9. Related ECN No(s).
608113

This ECN provides a minor modification to the gas sample probe in order to install a gas sample conditioning system on selected SHMS systems.

13a. Justification (mark one)

Criteria Change	[]	Design Improvement	[X]	Environmental	[]	Facility Deactivation	[]
As-Found	[]	Facilitate Const	[]	Const. Error/Omission	[X]	Design Error/Omission	[]

13b. Justification Details

Water accumulation in certain SHMS systems from condensation requires that additional sample gas conditioning be performed in order to prevent plugging of the system.

14. Distribution (include name, MSIN, and no. of copies)

DB Engelman	L6-37 (1)	DT Lott	R3-25 (1)
JM Jones	S5-13 (1)	CC Scaief	S2-01 (1)
TC Schneider	L6-37 (1)	CV Vo	L6-37 (1)
DD Tate	L6-37 (1)	RE Raymond	S7-12 (1)
HW Henrikson	R3-28 (1)		
Tank Farm Information Center	R1-28 (1)		

RELEASE STAMP

A-7900-013-2 (11/94) GEF095

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1) 625238

15. Design Verification Required	16. Cost Impact				17. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[] Yes	Additional	[] $ N/A	Additional	[] $ N/A	Improvement	[] N/A
[X] No	Savings	[] $ N/A	Savings	[] $ N/A	Delay	[] N/A

18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Tickler File	[]
Environmental Report	[]	Inspection Plan	[]	None	[]
Environmental Permit	[]	Inventory Adjustment Request	[]		

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
N/A		

20. Approvals

Signature	Date	Signature	Date
OPERATIONS AND ENGINEERING		ARCHITECT-ENGINEER	
Cog. Eng. TC Schneider		PE RL Fritz - Proj mgr	R/E-8-16-96
Cog. Mgr. DB Engelman		QA	
QA HW Henrikson		Safety	
Safety		Design BD Groth BD Groth	8/15/96
Environ.		Environ.	
Other DT Lott		Other	
CC Scaief			
DD Tate			
JM Jones		DEPARTMENT OF ENERGY	
		Signature or a Control Number that tracks the Approval Signature	
		ADDITIONAL	

This ECN adds a tee and a valve on the hydrogen monitoring gas sample return line in order to installa a condensate return line on systems where a Gas Sample Conditioner is installed.

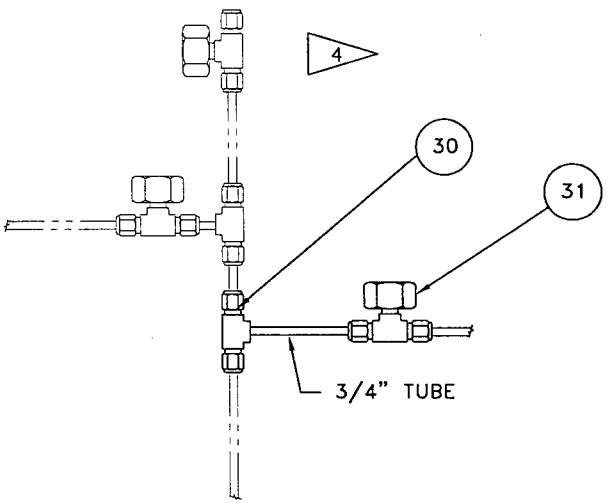
Change H-2-85678, rev. 0, sh. 1 as follows

PARTS / MATERIALS LIST				
QTY	PART/DASH NUMBER	NOMENCLATURE/DESRIPTION	MATERIAL / REFERENCE	ITEM
1	SS-810-3-8-6	Union Tee, 1/2"run with 3/8" branch	Swagelok	30
1	SS-6BG	Valve, 3/8" Bellow Seal	Nupro	31

Add general note

4. P/N 30 and 31 are only installed on vapor probes where the Gas Sample Conditioner for the Standard Hydrogen Monitoring System is installed. Refer to H-2-87275.

ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-85678	1	0	ECN No. 625238	4 OF 4

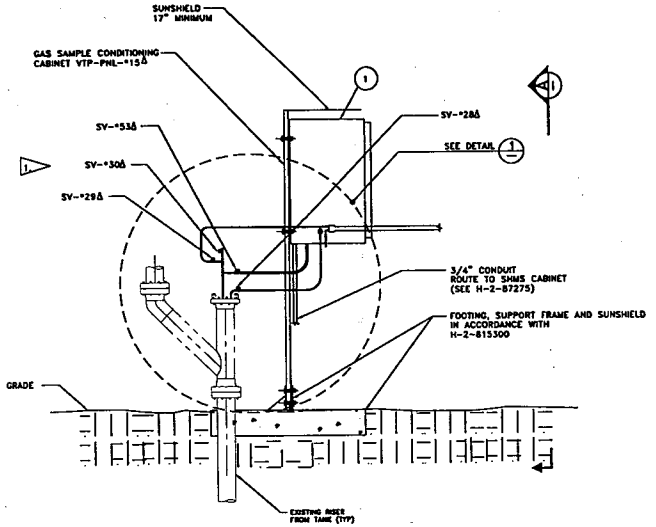


RETURN LINE

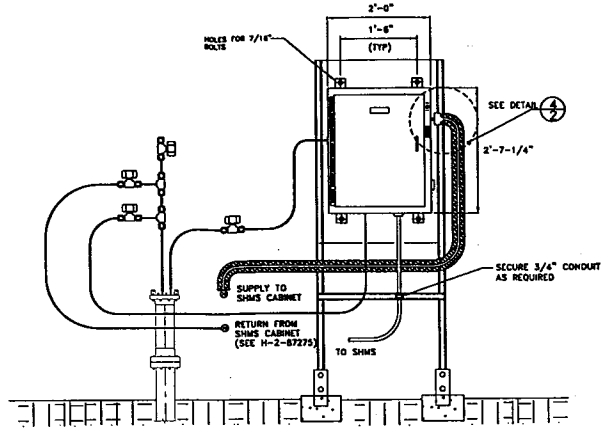
GENERAL NOTE

4 INSTALL PARTS 30 AND 31 ONLY WHERE GAS SAMPLE CONDITIONING CABINET IS INSTALLED. REFER TO H-2-87275.

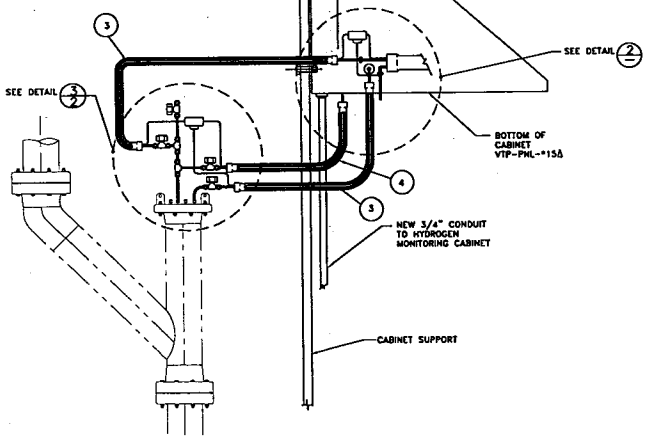
(STANDARD HYDROGEN MONITORING SYSTEM)



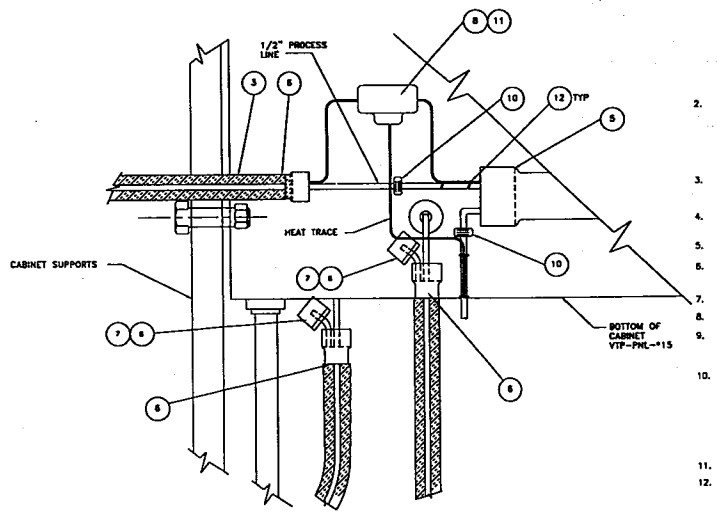
TYPICAL ELEVATION
SCALE: NONE



SECTION A
SCALE: NONE



DETAIL 1
SCALE: NONE



HEAT TRACE DETAIL (TYP) 2
SCALE: NONE

PARTS/MATERIAL LIST

QTY REQD	PART/DASH NUMBER	NOMENCLATURE/DESCRIPTION	MATERIAL/REFERENCE	SHEET	ITEM NO
1	WHC-S-0480	GAS SAMPLE CONDITIONING SYSTEM PER PROCUREMENT SPECIFICATION WHC-S-0480			1
1	SS-8BG	3/8" BELLOWS SEAL VALVE	NUPRO		2
AR	TPE-B4-B10	PREINSULATED AND HEAT TRACED TUBING, ONE 1/2" x 0.049 WALL, 316SS PROCESS LINES	O'BRIEN CORPORATION		3
AR	TPE1-F3-B10	PREINSULATED AND HEAT TRACED TUBING, ONE 3/8" x 0.035 WALL, 316SS PROCESS LINES	O'BRIEN CORPORATION		4
1	TPHOS-B3	END SEAL, TWO TUBE	O'BRIEN CORPORATION		5
2	TBHOS-02	END SEAL, ONE TUBE	O'BRIEN CORPORATION		6
3	PMKG-LE	END SEAL KIT	RAYCHEM		7
AR	RCD	CROMMENT FOR HEAT TRACE	RAYCHEM		8
1	SS-810-3-8-6	UNION TEE, 1/2", 3/8" BRANCH	SWAGELOK		9
2	SS-810-6	1/2" UNION	SWAGELOK		10
2	PMKG-LT	TEE KIT	RAYCHEM		11
AR	GS-54	GLASS INSTALLATION TAPE	RAYCHEM		12

NOTES:

1. FOR VALVE AND PANEL NUMBERS
   Δ INDICATES TANK NUMBER WHERE SYSTEM IS INSTALLED
   (A=101, B=102, C=103, ETC)
   * INDICATES THE TANK FARM WHERE THE SYSTEM IS INSTALLED
   8 = 241-A
   9 = 241-AX
   33 = 241-S
   34 = 241-SX
   38 = 241-U
2. FIELD ROUTE TUBING ALONG APPROXIMATE ROUTE SHOWN ON INSTALLATION DRAWINGS. MINIMUM TUBING BEND RADIUS
   INSULATED: 8 INCHES
   UNINSULATED: 3 INCHES
3. SPLICE HEAT TRACE FROM EXISTING TWO TUBE PROCESS LINE TO NEW SINGLE TUBE PROCESS LINES. UTILIZE P/N 12 AS AS NECESSARY TO SECURE HEAT TRACE TO TUBING.
4. LABEL CABINET USING ENGRAVED NAMEPLATE ATTACHED WITH CLEAR SILICONE ADHESIVE (ANY GRADE).
5. SEE H-2-87275 FOR LOCATIONS INSTALLED.
6. MINIMUM TUBING BEND RADIUS WHEN JACKETED 8" WHEN UNJACKETED 3" .
7. INSTALL ALL COMMERCIAL ITEMS PER MANUFACTURER'S INSTRUCTIONS.
8. HEAT TRACE LINES TERMINATED PER MANUFACTURER'S INSTRUCTIONS.
9. FABRICATION AND EQUIPMENT INSTALLATION SHALL BE PER THE EQUIPMENT INSTALLATION INSTRUCTION WHC-SD-WM-ER-003, SECTIONS 07900 AND 16400.
10. PROVIDE CERTIFICATION OF MEGGER TESTING INSTALLED HEAT TRACE CABLING PER MANUFACTURER'S TEST PERFORMANCE INSTRUCTIONS. DISCONNECT ALL ASSOCIATED DEVICES, DURING TESTING, NOT CAPABLE OF WITHSTANDING TEST VOLTAGE OR CURRENT. MINIMUM ACCEPTABLE INSULATION RESISTANCE IS 200 MEGOHMS AT 2500 VDC. REPAIR ALL VARIANCES. TESTING TO BE CONDUCTED BY THE PERFORMING CRAFT USING CALIBRATED TEST INSTRUMENTS CERTIFIED TRACEABLE TO NIST STANDARDS.
11. PREPARE ALL PROCESS LINE ENDS PER DETAIL E, ON H-2-87281.
12. EXTEND SPLICE KIT OR SLEEVE UNDER HEAT SHRINK BOOT. BOOT END SHOULD EXTEND TO WITHIN 9/16 ± 1/16 INCH OF THE TUBE FITTINGS WHERE INSTALLED.

DRAWING TRACEABILITY LIST	
DWG NO	TITLE
REFERENCES	
NEXT USED ON	

REVISIONS								
LTR	REV NO	DESCRIPTION	REV BY	REV DATE	ENGR APPROVAL	ENGR APPROVAL DATE	APPROVALS	DATE
CAD/E FILE			CADCODE					

APPROVAL PRINT

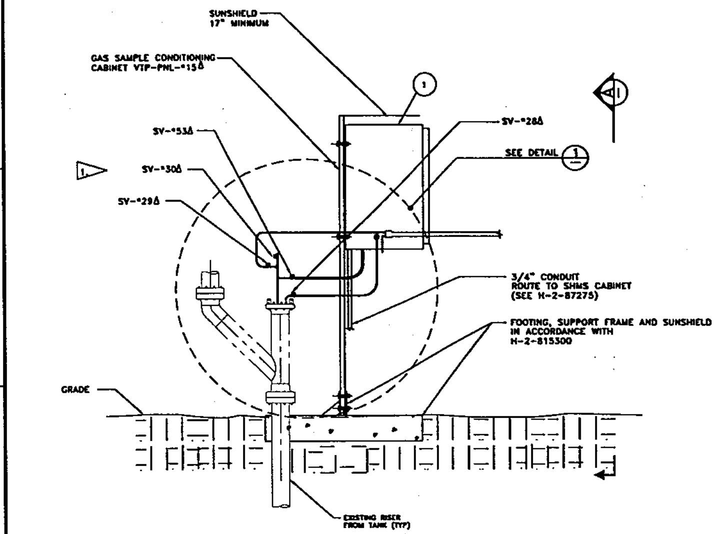
DRAWN	C.E. HICKS	6/27/96
CHECKED		
ENGR	B. GROTH	
PROJ ENGR		
PROJ MGR		
QA		
SAFETY		
ENVIRON		
OPER SUPT		
CM		

U.S. DEPARTMENT OF ENERGY
DOE Operations Office, Richland
ARES Corporation

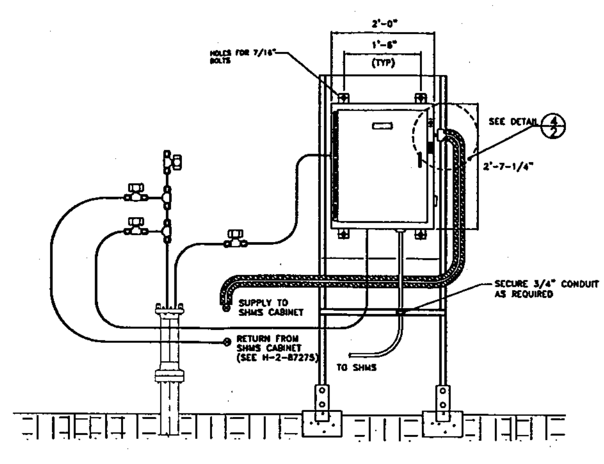
STANDARD HYDROGEN MONITORING SYSTEM GAS SAMPLE CONDITIONER INSTALLATION DETAILS

SIZE F | CLASS NO | WHSE NO | DWG NO H-14-100859 | REV 0
SCALE NONE | SHEET 1 OF 2

54-6000-027(5/88)

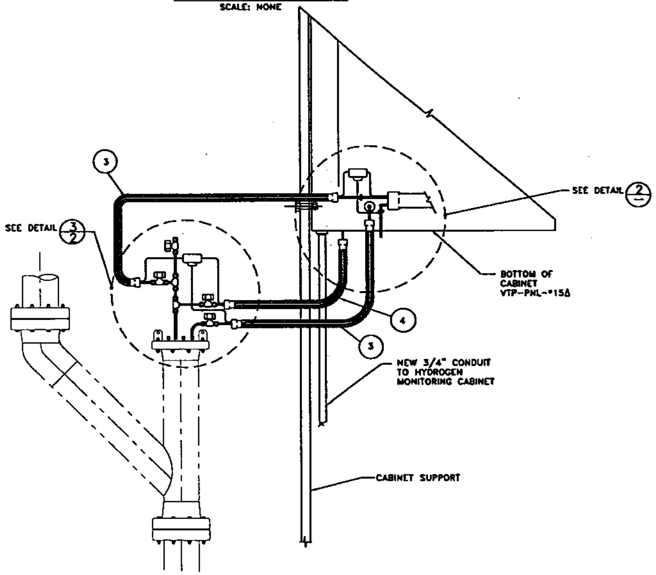


TYPICAL ELEVATION
SCALE: NONE

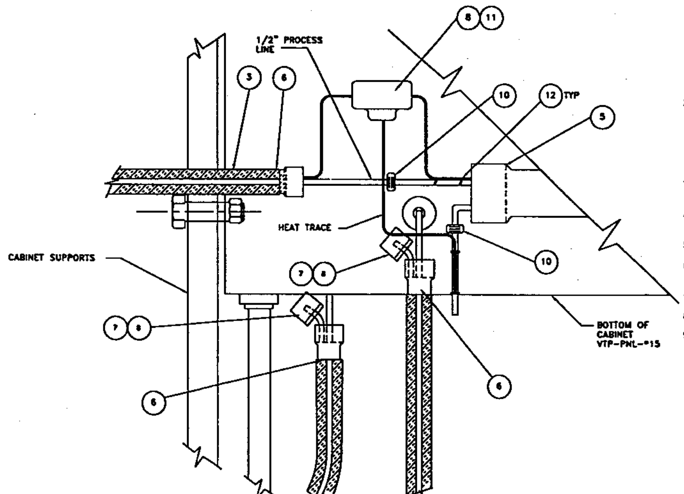


SECTION A
SCALE: NONE

PARTS/MATERIAL LIST					
QTY RQD	PART/DASH NUMBER	NOMENCLATURE/DESCRIPTION	MATERIAL/REFERENCE	SHEET	ITEM NO
1	WHC-S-0480	GAS SAMPLE CONDITIONING SYSTEM PER PROCUREMENT SPECIFICATION WHC-S-0480			1
1	SS-8BG	3/8" BELLOWS SEAL VALVE	NUPRO		2
AR	TPE-B4-B10	PREINSULATED AND HEAT TRACED TUBING, ONE 1/2" X 0.049 WALL, 316SS PROCESS LINES	O'BRIEN CORPORATION		3
AR	TPE1-F3-B10	PREINSULATED AND HEAT TRACED TUBING, ONE 3/8" X 0.035 WALL, 316SS PROCESS LINES	O'BRIEN CORPORATION		4
1	TPKHS-B3	END SEAL, TWO TUBE	O'BRIEN CORPORATION		5
2	TBKHS-02	END SEAL, ONE TUBE	O'BRIEN CORPORATION		6
3	PMKG-LE	END SEAL KIT	RAYCHEM		7
AR	RED	GROMMENT FOR HEAT TRACE	RAYCHEM		8
1	SS-810-3-8-6	UNION TEE, 1/2", 3/8" BRANCH	SWAGELOK		9
2	SS-810-6	1/2" UNION	SWAGELOK		10
2	PMKG-LT	TEE KIT	RAYCHEM		11
AR	GS-54	GLASS INSTALLATION TAPE	RAYCHEM		12



DETAIL 1
SCALE: NONE



HEAT TRACE DETAIL (TYP) 2
SCALE: NONE

NOTES:

1. FOR VALVE AND PANEL NUMBERS
   Δ INDICATES TANK NUMBER WHERE SYSTEM IS INSTALLED (A=101, B=102, C=103, ETC)
   * INDICATES THE TANK FARM WHERE THE SYSTEM IS INSTALLED
   8 = 241-A
   9 = 241-AX
   33 = 241-S
   34 = 241-SX
   38 = 241-U
2. FIELD ROUTE TUBING ALONG APPROXIMATE ROUTE SHOWN ON INSTALLATION DRAWINGS. MINIMUM TUBING BEND RADIUS
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   UNINSULATED: 3 INCHES
3. SPLICE HEAT TRACE FROM EXISTING TWO TUBE PROCESS LINE TO NEW SINGLE TUBE PROCESS LINES. UTILIZE P/N 12 AS AS NECESSARY TO SECURE HEAT TRACE TO TUBING.
4. LABEL CABINET USING ENGRAVED NAMEPLATE ATTACHED WITH CLEAR SILICONE ADHESIVE (ANY GRADE).
5. SEE H-2-87275 FOR LOCATIONS INSTALLED.
6. MINIMUM TUBING BEND RADIUS WHEN JACKETED 8" WHEN UNJACKETED 3".
7. INSTALL ALL COMMERCIAL ITEMS PER MANUFACTURER'S INSTRUCTIONS.
8. HEAT TRACE LINES TERMINATED PER MANUFACTURER'S INSTRUCTIONS.
9. FABRICATION AND EQUIPMENT INSTALLATION SHALL BE PER THE EQUIPMENT INSTALLATION INSTRUCTION WHC-SD-WM-EN-003, SECTIONS 07900 AND 16400.
10. PROVIDE CERTIFICATION OF MEGGER TESTING INSTALLED HEAT TRACE CABLING PER MANUFACTURER'S TEST PERFORMANCE INSTRUCTIONS. DISCONNECT ALL ASSOCIATED DEVICES, DURING TESTING, NOT CAPABLE OF WITHSTANDING TEST VOLTAGE OR CURRENT. MINIMUM ACCEPTABLE INSULATION RESISTANCE IS 200 MEGOHMS AT 2500 VDC. REPAIR ALL VARIANCES. TESTING TO BE CONDUCTED BY THE PERFORMING CRAFT USING CALIBRATED TEST INSTRUMENTS CERTIFIED TRACEABLE TO NIST STANDARDS.
11. PREPARE ALL PROCESS LINE ENDS PER DETAIL E, ON H-2-87281.
12. EXTEND SPLICE KIT OR SLEEVE UNDER HEAT SHRINK BOOT. BOOT END SHOULD EXTEND TO WITH-IN 9/16 ± 1/16 INCH OF THE TUBE FITTINGS WHERE INSTALLED.

REF NUMBER	TITLE
H-2-87281	STANDARD HYDROGEN MONIT SYSTEM HEAT TRACE DETAILS
H-2-87275	STANDARD HYDROGEN MONIT SYSTEM DRAWING INDEX TREE
H-2-85268	SINGLE HEATED VAPOR TUBE DETAILS
H-2-85267	SINGLE HEATED VAPOR TUBE INSTALLATION
H-2-815300	TBX-TMACS-GEN SUPPORT INSTALLATION

APPROVAL PRINT

CE HICKS
B. GROTH

U.S. DEPARTMENT OF ENERGY
DOE Operations Office, Richland
ARES Corporation

STANDARD HYDROGEN MONITORING SYSTEM GAS SAMPLE CONDITIONER INSTALLATION DETAILS

F H-14-100859 0
SCALE: NONE SHEET 1 of 2

54-6000-027(5/86)

WHC-SD-WM-ER-621, Rev.

ENGINEERING CHANGE NOTICE

Page 1 of _____

1. ECN 603493

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental [ ] Direct Revision [ ] Change ECN [X] Temporary [ ] Standby [ ] Supersedure [ ] Cancel/Void [ ]	BD Groth, ARES Corp., Richland, WA, 946-3300	[X] Yes [ ] No	09/16/96
	6. Project Title/No./Work Order No.	7. Bldg./Sys./Fac. No.	8. Approval Designator
	SHMS Sample Conditioning/N2165	241-AY-102	SQ
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.)	10. Related ECN No(s).	11. Related PO No.
	See block 12	625236	N/A

12a. Modification Work	12b. Work Package No.	12c. Modification Work Complete	12d. Restored to Original Condition (Temp. or Standby ECN only)
[X] Yes (fill out Blk. 12b) [ ] No (NA Blks. 12b, 12c, 12d)		Design Authority/Cog. Engineer Signature & Date	Design Authority/Cog. Engineer Signature & Date

13a. Description of Change

13b. Design Baseline Document? [X] Yes [ ] No

Block 9, Document Numbers Changed

ECN W-369-56
H-2-64341, sh. 1, rev. 4
H-2-64348, sh. 1, rev. 4
H-2-64403, sh. 1, rev. 13

14a. Justification (mark one)

Criteria Change	[ ]	Design Improvement	[X]	Environmental	[ ]	Facility Deactivation	[ ]
As-Found	[ ]	Facilitate Const	[ ]	Const. Error/Omission	[ ]	Design Error/Omission	[ ]

14b. Justification Details

Water accumulation in certain SHMS systems from condensation requires that additional sample gas conditioning be performed in order to prevent plugging of the system.

15. Distribution (include name, MSIN, and no. of copies)

ICF KH DISTRIBUTION		M.N. Islam	S5-13
Const Doc Cntl	S2-53	T.C. Schneider	L6-37
WHC DISTRIBUTION		G.R. Tardiff	S5-05
K.C. Douka	T4-07	D.D. Tate	L6-37
R.L. Golberg	R3-25	M.S. Tiffany	S5-05
W.M. Harty	S5-13	J.E. Wells	S5=05
H.W. Henrikson	R3-28	J.B. Witt	R3-28

RELEASE STAMP

A-7900-013-2 (05/96) GEF095

A-7900-013-1 (08/92)

ENGINEERING CHANGE NOTICE

ECN (continued from pg. 1) 603493

16. Design Verification Required	17. Cost Impact				18. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[] Yes	Additional	[] $	Additional	[] $	Improvement	[]
[] No	Savings	[] $	Savings	[] $	Delay	[]

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Tickler File	[]
Environmental Report	[]	Inspection Plan	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

20. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision

21. Approvals

Signature	Date	Signature	Date
Design Authority WJ Powell		Design Agent BD Groth	
Cog. Eng. GR Tardiff		PE	
Cog. Mgr. GN Hanson		QA	
QA HW Henrikson		Safety	
Safety MN Islam		Design	
Environ.		Environ.	
Other		Other	
		DEPARTMENT OF ENERGY	
		Signature or a Control Number that tracks the Approval Signature	
		ADDITIONAL	

This ECN changes ECN W-369-56 in order to add a gas sample conditioning cabinet for the SHMS installation on 102-AY. The purpose of this gas sample conditioner is to remove moisture from the gas sample stream and return the resulting condensate to the tank. A summary of changes is as follows:

1. Changes page 11 to add conduit run P55 from the 102-AY SHMS cabinet to the Gas Sample Conditioning Cabinet.

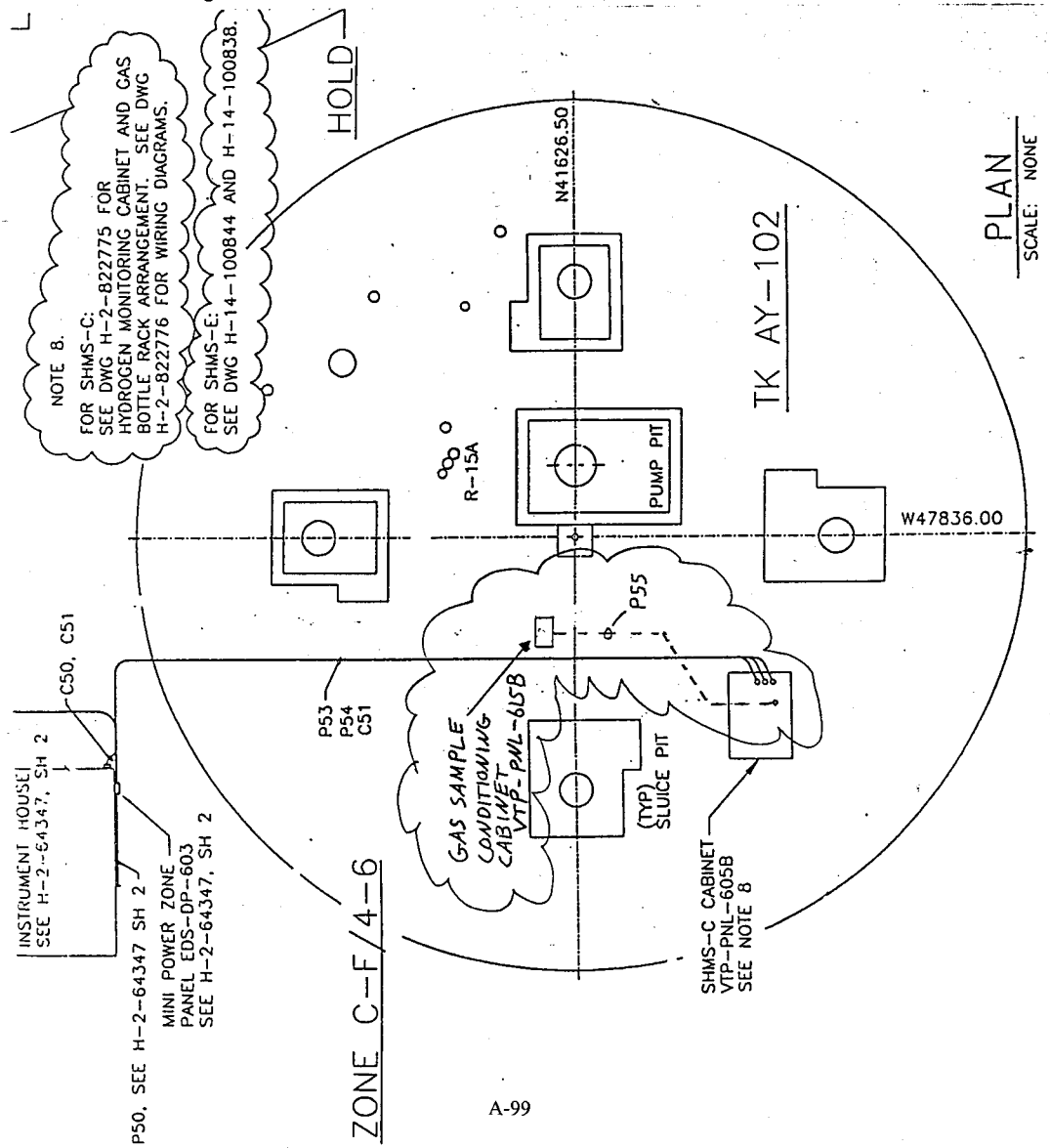
2. Changes page 12 to add conduit run P55 and wire run 355 to the wire and conduit run schedules.

3. Changes page 17 to show overall plan view of Gas Sample Conditioner Cabinet location and orientation.

4. Changes page 18 to show Gas Sample Conditioner Cabinet orientation details.

Change ECN W-369-56, Page 11 as follows to add conduit run P55

Reference Drawing: H-2-64341, sh. 1, rev. 4



Change ECN W-369-56, Page 12 as follows to add conduit run P55 and wire run 355

Reference Drawing: H-2-64348, sh. 1, rev. 4

Zone A-B/8-13

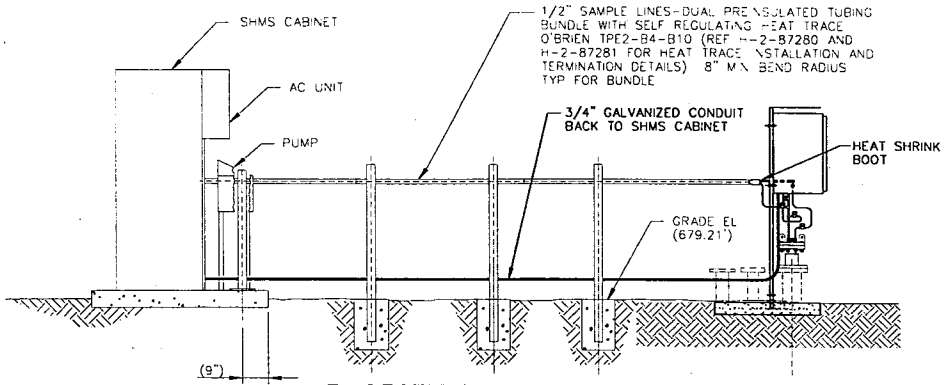
WIRE RUN NO	NO OF WIRES	SIZE OF WIRE	TYPE OF WIRE	FROM	VIA	TO	WIRE NUMBERS
355	3	12	20	VTP-PNL-605B	P55	VTP-PNL-615B	VTP-PLN-615B-H,N,G

Zone E-F/4-6

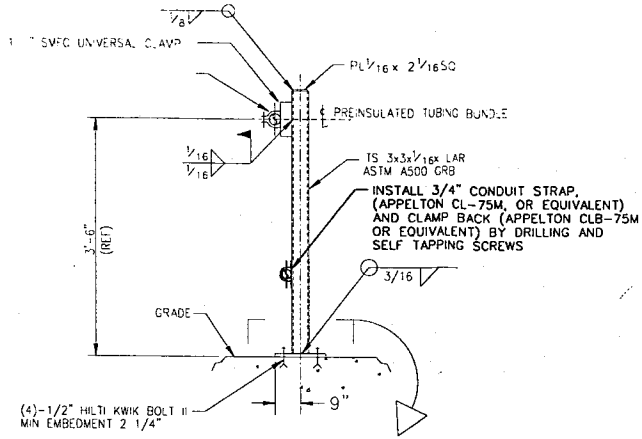
CONDUIT SCHEDULE		
CND NO	CND SIZE	WIRE RUN NUMBER
P55	3/4	355

ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-64403	1	13	ECN No. 603493	7 OF 7

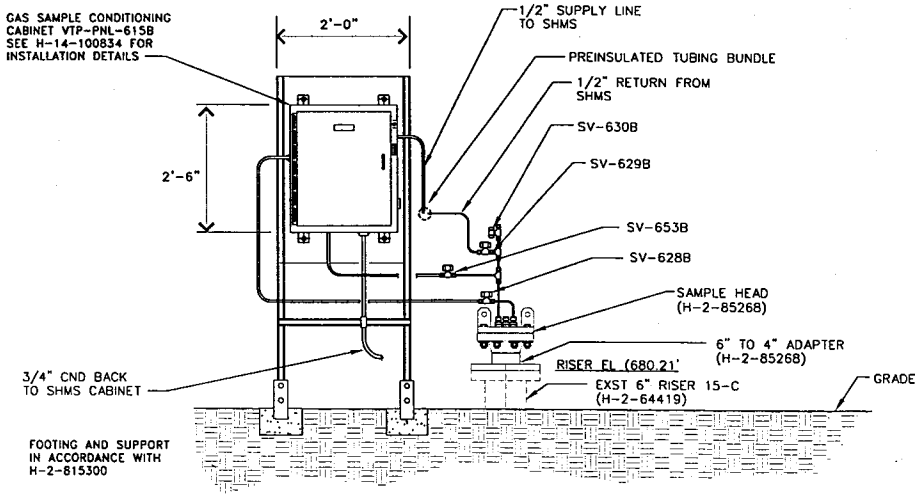
CHANGE ECN W369-56, PAGE 18 AS FOLLOWS



B SECTION
SCALE: NONE



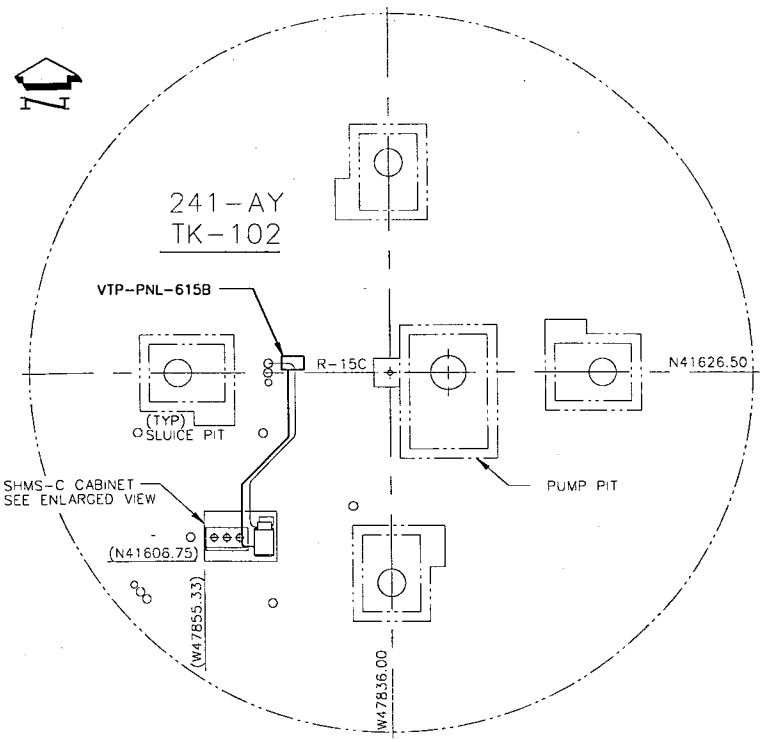
3 DETAIL
SCALE: NONE



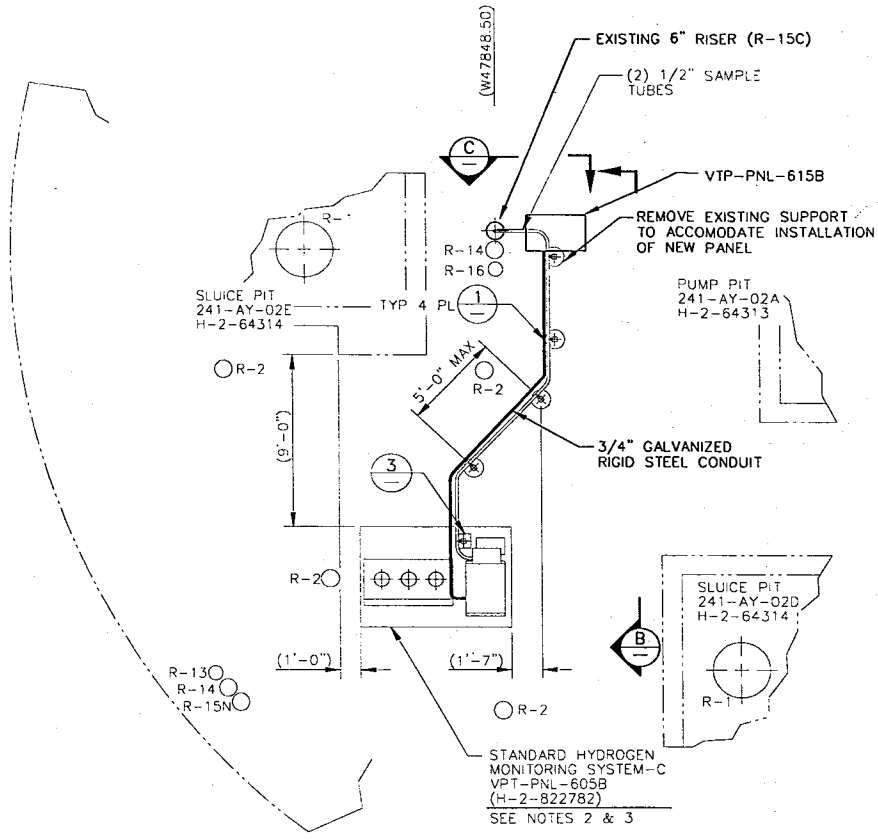
C SECTION
SCALE: NONE

ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-64403	1	5	ECN No. 603493	6 OF 7

CHANGE ECN W369-56, PAGE 17 AS FOLLOWS



PLAN
SCALE: NONE



ENLARGED VIEW
SCALE: NONE

Appendix B
Gas Sample Conditioner Procurement Specification

PROCUREMENT SPECIFICATION
No. WHC-S-0480
Revision 2

STANDARD HYDROGEN MONITORING SYSTEM GAS SAMPLE CONDITIONER

Prepared for

WESTINGHOUSE HANFORD COMPANY
Purchase Order MSJ-SBW-336070
Report No. 961140-001
Revision 2

August 1996

Prepared by

ARES CORPORATION
636 Jadwin Avenue, Suite B
Richland, Washington 99352

PROCUREMENT SPECIFICATION
No. WHC-S-0480
Revision 2

STANDARD HYDROGEN MONITORING SYSTEM GAS SAMPLE CONDITIONER

Prepared for

WESTINGHOUSE HANFORD COMPANY
Purchase Order MSJ-SBW-336070
Report No. 961140-001
Revision 2

August 1996

Prepared by: Bruce D. Groth

Approved by: R. L. Fritz

Date: 8-16-96

PROCUREMENT SPECIFICATION
No. WHC-S-0480
Revision 2

STANDARD HYDROGEN MONITORING SYSTEM
GAS SAMPLE CONDITIONER

Specification No.	Rev/Mod	Date	Page
WHC-S-0480	2	August 14, 1996	1 of 20

GAS SAMPLE CONDITIONER PROCUREMENT SPECIFICATION

TABLE OF CONTENTS

GAS SAMPLE CONDITIONER PROCUREMENT SPECIFICATION

LIST OF TABLES

GAS SAMPLE CONDITIONER PROCUREMENT SPECIFICATION

ACRONYMS

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
FM	Factory Mutual
ISA	Instrument Society of America
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
QAP	Quality Assurance Program
SCFM	Standard Cubic Feet Per Minute
UBC	Uniform Building Code
UL	Underwriters Laboratory
VI	Vendor Information

GAS SAMPLE CONDITIONER PROCUREMENT SPECIFICATION

1.0 SCOPE

This specification establishes the requirements for design and fabrication of a gas sample conditioning system for the removal of water vapor from a gas sample stream. The sample stream is monitored for hydrogen gas which may be present in the vapor space of underground radioactive waste storage tanks. The gas sample stream may also be used to monitor for ammonia vapor. The gas sample conditioning system will be installed upstream of an existing gas sampling and monitoring system that includes a vacuum sampling pump.

1.1 WORK SCOPE

The work identified to be performed under this specification is as follows:

- Design, fabricate, test, and deliver a gas sample conditioning system for the removal of moisture from gas sample streams. The system shall be mounted in an environmentally controlled cabinet for use in an outdoor area.
- Provide design, acceptance testing, quality assurance documentation, and operations documentation on the provided system.
- Provide vendor submittals including clear and concise documentation on installation, operation, maintenance, etc.
- Certify that the system is FM approved for operations in a Class I, Division II, Group B hazardous environment as defined in NFPA 70.
- Certify that supplied equipment meets all requirements of the specification, Industrial Safety Standards, and applicable OSHA guidelines.

These items to be supplied by Seller are further defined in Section 4.5.

1.2 WORK NOT INCLUDED

Work that will be performed by Buyer includes the following:

- Field installation of wiring and piping.
- Field connection to electrical service lines.
- Start-up testing.

2.0 APPLICABLE DOCUMENTS

2.1 REQUIRED COMPLIANCE

The Seller shall comply with all requirements outlined in the documents referenced in this section.

2.1.1 American National Standards Institute (ANSI)

ANSI Y14.1-1980	"American National Standard Drawing Sheet Size and Format"

2.1.2 National Fire Protection Association (NFPA)

NFPA 70 - 1996	"National Electrical Code"

GAS SAMPLE CONDITIONER PROCUREMENT SPECIFICATION

3.0 SYSTEM REQUIREMENTS

3.1 GENERAL DESCRIPTION

The gas sample conditioning system will consist of all equipment necessary to reduce the dew point of the defined sample gas stream to between 41 degrees F (5 deg. C) and 70 degrees F (21 deg. C). The sample gas stream is defined in Section 3.2.2. The condensed vapor shall be routed back to the tank from which the gas sample stream was withdrawn. The condenser will operate in a vacuum of approximately 0 to -6 inches of water. The system shall be self contained, i.e. capable of assembly, operation, and testing prior to transportation to the Buyer's site for installation.

3.1.1 Equipment Cabinet

The equipment cabinet section shall contain all the equipment necessary to perform the required sample gas conditioning. The cabinet shall be a NEMA 4 rated cabinet, insulated and cooled and heated as necessary to withstand the environmental conditions defined in Section 3.2.1. The cabinet shall contain mounting tabs with a vertical separation of 31-1/4 ± 1/8 inches and a horizontal separation no greater than 20 inches.

3.1.2 Conditioner/Condenser

The gas sample conditioner/condenser shall be an impingement type designed to minimize the gas/liquid contact and, therefore, the stripping of soluble gases. The conditioner/condenser shall be chilled thermoelectrically (Peltier effect).

3.1.3 Condensate Handling

The condensate will be routed back to the tank from which the gas sample is drawn. A peristaltic pump, capable of handling the volume of water removed from the defined sample gas stream, shall be provided by the Seller as part of the gas sample conditioning system to perform this. The Buyer shall provide the condensate return line from the equipment cabinet bulkhead fitting to the tank as described in Section 3.3.2. A leak tight drip pan shall be located below the peristaltic pump to collect the condensate in the event of a leak in the peristaltic pump. The drip pan will contain a leak detector as described in Section 3.4.3.

3.2 ENVIRONMENT

The ambient and gas sample stream environmental conditions are specified in this section. The gas sample conditioning system will be required to operate under these conditions.

3.2.1 Ambient Environment

The general environmental conditions at the Hanford Site are as listed in Table 1. The gas sample conditioning system shall be designed to operate in these general conditions. The interior of the cabinet will periodically be exposed to the outside ambient conditions for short periods of time during inspections and maintenance.

TABLE 1

Condition	Range
Ambient Air Temperature	-20°F to 110°F.
Relative Humidity	15% to 90%
Rain	0.60 inch per hour maximum
Snow, Sleet, Hail	Eight inches of snow maximum in 24 hours, with 14 inches of snow maximum accumulation. Sleet and hail account for less than 1 percent of frozen precipitation. Maximum hailstone diameter is 3/8 inches. The site is subject to blowing and drifting snow. Glaze occurs approximately six days a year.
Blowing Dust (dust blown about in clouds or sheets)	Restricts visibility up to six miles or less. May completely obscure sky. Occurs approximately ten times a year. Approximately 24-hour duration for each occurrence.
Radiation	Up to 100 mr/hr
Solar Radiation	300 plus days direct sunlight per year
Wind/Seismic	80 mph maximum wind. Seismic to UBC.

3.2.2 Gas Sample Stream Conditions

The general environmental conditions existing in the sample stream are as listed in Table 2 below. The gas sample conditioning system shall be capable of operation in these general conditions to reduce the dew point of the sample gas stream to 70 degrees F (21 deg. C) or below.

TABLE 2

Condition	Range
Temperature	Maximum of 150°F
Relative Humidity	Maximum 100 percent
Gas Flow Rate	0.4 to 0.5 SCFM
Gas Content - The following is a list of gases that may be present in the sample stream. The list is not inclusive and other unknown gases may be present.	Hydrogen: typically 50-100 ppm, occasionally 1-4 percent Ammonia: typically 100-200 ppm Nitrous Oxide: typically 50-100 ppm
Radioactive particulate	Low levels of radioactive particulates may be present in the gas sample stream

3.3 INTERFACE REQUIREMENTS

3.3.1 Gas Sample Tubing

The existing gas sample tubing is ½ inch OD 304 or 304L seamless stainless steel with a wall thickness of 0.049 inches. Bulkhead fittings shall be located in the equipment enclosure of the gas sample conditioning system in order to interface with the existing tubing.

3.3.2 Condensate Return Line

The condensate return line shall transition to a single stainless steel bulkhead tube fitting for 3/8 inch OD tubing at the equipment enclosure wall. The condensate return line from the cabinet back to the tank will be provided by the Buyer. The tubing up to the bulkhead fitting at the

enclosure wall shall be provided by the Seller and will be no more than six feet long, with an elevation increase of no more than two feet..

3.3.3 Utilities Available

The gas sample conditioning system shall operate with available power provided over a range of 117±15 V, single phase AC at a frequency of 57 to 61 Hz, from a 15 amp feeder breaker. There are no other utilities available at the site.

3.4 INSTRUMENTATION AND ALARMS

3.4.1 Moisture Alarm

The gas exhaust stream from the gas sample conditioner shall be monitored for moisture. If the dew point exceeds 70 degrees F, an alarm consisting of a flashing amber light on top of the equipment enclosure shall be initiated. The alarm shall automatically reset upon return of the dew point to below 70 degrees F.

3.4.2 Temperature Monitoring

The gas exhaust stream from the sample gas conditioner shall be monitored for temperature so that the amount of cooling can be adjusted if desired (see Section 3.7.3). The exhaust temperature shall be displayed at the equipment cabinet.

3.4.3 Leak Detector

The peristaltic pump drip pan shall be equipped with a leak detector to determine the presence of liquids (primarily water) in the pan. The detector shall actuate a flashing amber light on top of the equipment enclosure. This light may be the same light used for the moisture alarm.

3.5 MATERIAL REQUIREMENTS

3.5.1 Transport Tubing, Fittings, and Condensers

All components (tubing, fittings, and condensers) of the gas sample conditioning system in contact with the gas sample stream shall be fabricated from type 316, 316L, 304 or 304L stainless steel. All tubing shall be of seamless construction with material composition per American Society for Testing and Materials (ASTM) A269 and be of appropriate wall thickness. An exception to this is the peristaltic pump tubing which will be a plastic tubing specified by the Seller.

3.5.2 Instrument Cabinet and Housings

Instrumentation cabinets or other outdoor housings shall be NEMA 4 and weather and corrosion resistant. They shall be fabricated from carbon or stainless steel sheet metal. The surfaces (inside and outside) of the cabinets shall be resistant to rust and corrosion either through painting/coating, or material selection. Door latches shall be operated by hand, no tools shall be required.

3.5.3 Electrical Component Listing

Electrical materials and equipment shall be UL- or FM-tested, with label attached, for the purpose intended, whenever such products are available. Where there are no UL- or FM-listed products of the type, testing and certification by another nationally recognized testing agency may be acceptable. Installation methods shall be in accordance with the manufacturer's instructions, with NFPA 70, and with other applicable requirements. Where electrical components recognized by a national testing agency are used, the component shall be installed in accordance with those listings. If any electrical components come in contact with the gas sample stream, they shall be certified to be intrinsically safe for a Class I, Division I, Group B hazardous environment as defined in NFPA 70.

The system shall be FM approved for use in a Class I, Division II, Group B hazardous environment as defined in NFPA 70.

3.5.4 General Materials

All materials used shall be new and as specified on the Seller design drawings. All fasteners (nuts, bolts, washers) and structural materials shall meet ANSI and ASME standards. The use of non-encapsulated lead or asbestos is not permitted. Insulation material shall be free of halogenated hydrocarbons.

3.6 FABRICATION REQUIREMENTS

Wiring shall be in accordance with the latest edition of the National Electrical Code. Construction shall conform to standard industrial practices.

The fabricator shall maintain a system of process controls and procedures that will ensure compliance with requirements for soldering, brazing, and other fabrication and assembly processes, engineering drawings and specifications, and industry standards.

3.7 OTHER REQUIREMENTS

3.7.1 System Leak Testing

The sample gas transport system piping connections shall be leak tested using a bubble or other approved method.

3.7.2 Sample Gas Holdup Time

The gas sample hold up time in the gas sample conditioning system shall be shown to be no more than 15 seconds at a flow rate of 0.4 SCFM.

3.7.3 Dew Point Adjustment

The temperature of the gas sample conditioner exhaust shall be readily adjustable from within the equipment enclosure.

3.7.4 Component Labeling

All system components shall be labeled appropriately utilizing engraved nameplates with a white background and black lettering.

3.8 OPERATION AND SERVICE MANUALS

3.8.1 Six (6) copies of operating and service manuals shall be provided, with respect to the assembled system and purchased components, prior to shipment of the completed units. As-built circuit, assembly, and piping and instrumentation drawings shall be complete and accurate with respect to the system supplied. If blocks or squares are used to indicate a portion of the circuit or assembly, a complete drawing depicting the contents of the block or square shall be provided elsewhere in the manual. All individual components shall be identified and values or component identification codes shall be given either on the schematic drawings or on the parts list.

3.8.2 Seller shall provide a list of recommended spare parts, identifying each specific subassembly to which it applies. Seller shall indicate the minimum recommended inventory of the spare parts for installation, startup, and maintenance for a one-year period based on continuous operation. Seller shall state whether the recommended spare part is a stock item or a special item, and shall furnish name and location of the nearest suppliers, and approximate lead time.

3.8.3 Seller shall furnish all special tools unique to Seller's equipment, necessary for installation, startup, operation, maintenance and adjustment of the equipment and accessories furnished by the Seller. Seller shall provide a list of all special tools furnished, identifying the function of each tool and the specific task for which it is used. Seller shall also indicate whether the tool is required for assembly, disassembly, installation, startup, operation, maintenance, or adjustment. Detailed drawings or procurement information for the special tools shall be provided by Seller.

3.8.4 The Seller shall supply six (6) copies, in organized notebooks, of all catalog cuts for the gas sample conditioner components and instrumentation. Additionally, the Seller shall provide six (6) copies of all sub-vendor equipment manuals.

4.0 QUALITY ASSURANCE

4.1 PROGRAM

The Seller shall have in place an auditable quality system that meets the intent of the requirements listed below. A copy of the Sellers Quality Assurance Program (QAP) Manual shall be submitted with the proposal.

1. A written QAP Manual shall be developed, implemented, and maintained. The QAP Manual shall describe the organizational structure, functional responsibilities, levels of authority, and interfaces for those managing, performing, and assessing the work.

2. Documents shall be prepared, reviewed, approved, issued, used, and revised to prescribe processes, specify requirements, or establish design. Records shall be specified, prepared, reviewed, approved, and maintained.

3. Work shall be performed to established technical standards and administrative controls using approved instructions, procedures, or other appropriate means. Items shall be identified and controlled to ensure their proper use. Items shall be maintained to prevent their damage, loss, or deterioration. Equipment used for process monitoring or data collection shall be calibrated and maintained.

4. Items and processes shall be designed using sound engineering/scientific principles and appropriate standards. Design work, including changes, shall incorporate applicable requirements and design bases. Design interfaces shall be identified and controlled. The adequacy of design products shall be verified or validated by individuals or groups other than those who performed the work.

5. Inspection and testing of specified items, services, and processes shall be conducted using established acceptance and performance criteria. Equipment used for inspections and tests shall be calibrated and maintained.

4.2 SUBCONTRACTS

The Seller shall require, in writing, subcontractors of all tiers to comply with all applicable quality program requirements. The Seller and subcontractors of all tiers shall be subject to audit by the Buyer.

4.3 QUALITY ASSURANCE SUBMITTAL COMPLIANCE REQUIREMENTS

The Seller shall comply with the inspection and test plans submitted to and approved by the Buyer. All changes from the approved copy must be concurred with in writing by the Buyer.

4.4 TESTING

4.4.1 General

Acceptance tests will be conducted by the Seller and may be witnessed by the Buyer. Acceptance test plans detailing procedures, calibrated instruments being used, and acceptance criteria shall be written and submitted by the Seller to the Buyer for approval a minimum of two weeks prior to the acceptance test. Six (6) copies of the test results shall be provided to the Buyer.

4.5 SUBMITTALS

4.5.1 Submittals Required with Proposal

4.5.1.1 Proposed Schedule

A proposed schedule for accomplishment of the work will be submitted by the Seller with the proposal.

4.5.1.2 Quality Assurance Program

The Sellers Quality Assurance Program Manual shall be submitted with the proposal for approval by the Buyer.

4.5.1.3 List of Major Subcontractors

A list of the Sellers major subcontractors and their capabilities shall be submitted with the proposal for evaluation by the Buyer.

4.5.2 Submittals Required Prior to Fabrication

4.5.2.1 Preliminary Drawings and Specifications

The Seller shall provide preliminary drawings and specifications of the proposed assembly configuration for the Buyers review and approval prior to fabrication. Information on off-the-shelf components shall be provided from catalog cut-sheets. One week will be allowed for review by the Buyer on the proposed schedule.

4.5.2.2 Inspection and Test Plan

The Seller shall provide to the Buyer for review and approval an Inspection and Test Plan to include a sequential listing of the inspections and tests required for compliance with this contract. The Buyer shall reserve the right while reviewing this plan to identify in writing to the Seller inspection or testing activities to be witnessed by the Buyer representative. The Seller shall notify the Buyer no later than ten working days prior to any specified witness points. Witness points established by the Buyer shall not be waived except in writing.

4.5.3 Submittals Required for Contract Completion

4.5.3.1 As-Built Drawings and Specifications

The Seller shall delivery to the Buyer six (6) copies of the final assembly level as-built drawings and specifications accurately depicting the product delivered. Drawings shall include dimensional layouts, dimensioned subassemblies, dimensioned component details (if not included on manufacturers' cut sheets), flow and electrical diagrams, material and fastener sizes, descriptions, weld symbols, and notes. The designer's name, responsible engineer's name, bill of materials, and drawings numbers shall appear on the index (cover sheet).

Drawing size shall be size A (8½" by 11") or size F (28" by 40") per ANSI Y14.1. Bills of material on drawings shall include quantity, manufacturer, material type, electrical characteristics, size, and general description. All component parts shall refer to applicable material specifications, such as the Military, ASME, ASTM, Federal, or other specifications.

4.5.3.2 Inspection and Testing Reports

Inspections, examinations, and testing activities shall be documented and the documentation delivered at or before shipment of the product. Inspection Reports shall provide actual inspection results, specifying what was inspected, who inspected it, the characteristics inspected, and the acceptance criteria.

4.5.3.3 Operation and Service Manuals

The Seller shall provide the manuals required in Section 3.8.

4.5.3.4 Certificate of Conformance

The Seller shall provide a certificate of conformance stating in writing that supplied equipment meets all required specification, Industrial Safety Standards, and applicable OSHA guidelines.

4.5.3.5 Records Maintenance, Control, and Disposition

The Seller shall collect, identify, and maintain originals of records generated for this contract and included in the Submittal Schedule. Where contract records include generic procedures such as welding or NDE procedures, reproducible copies may be submitted instead of originals if validated.

Where submittals are required during the term of the contract for Buyer review, copies shall be submitted. Within ten days of final shipment, however, the originals (or validated reproducible copies) of the records shall be delivered to Buyer at a location specified by the Buyer's Contract Specialist. The record package shall be marked so as to distinguish it from the eight informational copies of documents required by Table 3. The originals of records which are not of reproducible quality shall be so identified. A reconstructed original or reproducible copy and the identified unusable original shall be included as a record.

All records shall be protected against damage, deterioration, loss or unauthorized use.

All records shall meet the following standards:

- signed, initialed, or otherwise authenticated and dated.
- traceable to the item or activity.
- legible, accurate, reproducible, and complete.
- corrected, if necessary, by the record originator, who shall mark out the incorrect information with a single line, enter the correct information, and then initial and date the correction. If the reason for the change is not obvious, then it must be stated.

TABLE 3

ITEM	PARAGRAPH REFERENCE	DESCRIPTION OF DOCUMENT	SUBMITTAL	REQUIRED
1	4.1	Quality Assurance Program Manual	Approval	With Proposal
2	4.2	Identification of Major Subcontractors	Evaluation	With Proposal
3	4.6.1.1	Preliminary Drawings and Specifications	Approval	Prior to Fabrication
4	4.6.1.2	Inspection & Test Plan	Approval	Prior to Fabrication
5	4.5.3.1	Final As-Built Drawings	Record	Shipment
6	4.6.2.2	Final Inspection and Test Reports	Record	Shipment
7	4.5.3.3	Final Assembly, Operation & Maintenance Instructions	Information	Shipment
8	4.6.2.4	Certificate of Conformance for Assembled System	Record	Shipment
9	3.8.2	Spare Parts List	Information	Shipment
10	4.6.2.5	Record Package	Record	Within 10 Days of Shipment

4.6 DOCUMENT CONTROL

4.6.1 Changes to Buyer's Documents

Changes to Buyer's Purchase Order requirements will be documented and submitter by the Seller to the Buyer for approval. Purchase Order Modifications which will be transmitted to Seller shall include the impact on the cost and schedule.

4.6.2 Changes to Seller's Documents

Changes to Seller's approved design shall be controlled by change control process approved by Buyer. Seller shall notify Buyer of proposed change. Detailed description of change, including justification for change, shall be included.

GAS SAMPLE CONDITIONER PROCUREMENT SPECIFICATION

5.0 HANDLING AND PACKAGING

5.1 PREPARATION

5.1.1 All shipping units shall have identification placards (manufacturers, subcontractor, etc). The information shall be easily viewed and unobstructed by other materials on the unit.

5.1.2 The placards shall indicate Buyer's purchase order number, shipping address, shipper's name, product name and model number, serial number (if applicable), year manufactured, and address and phone number of manufacturer.

5.1.3 The placards shall be durable (without degradation of the information on them) as items may be stored for an extended period in an outdoor environment.

5.2 CLEANING, PACKAGING, AND SHIPPING

5.2.1 If special handling devices are needed for assembly or installation of equipment, those devices shall be part of the Seller's package and identified as special equipment.

5.2.2 Each shipping unit shall be packaged to eliminate damage due to outside storage for up to one year or damage due to shipping and handling by forklift or hoist. Packages shall be marked at the factory with the Buyers purchase order number.

5.2.3 Lift points or centers of gravity shall be marked on shipping crates.

5.2.4 Material not shipped in a weatherproof vehicle shall be protected from the weather in a manner acceptable to the Buyer. The shipping procedures shall define the method of protecting components from the weather.

Appendix C
Water Accumulation Cost Estimate

SHMS Gas Sample Conditioner
Estimate Summary

WBS	Activity	Estimate Subtotal	Escalation %	Escalation Total	Subtotal	Contingency %	Contingency Total	Total Dollars
1.1	Engineering	$36,500	0.0%	$0	$36,500	25.0%	$9,125	$45,625
1.2	Procurement	$147,982	0.0%	$0	$147,982	5.0%	$7,399	$155,381
1.3	Construction	$76,675	0.0%	$0	$76,675	30.0%	$23,002	$99,677
1.4	Project Management	$15,496	0.0%	$0	$15,496	25.0%	$3,874	$19,370
1.5	Startup	$5,112	0.0%	$0	$5,112	25.0%	$1,278	$6,390
TOTAL		$281,764	0.0%	$0	$281,764	15.9%	$44,679	**$326,443**

Estimate Basis:

1. General labor rates for onsite work are based on WHC rates utilized for previous coneceptual designs and are as follows:
   a) Project Manager $76/hr
   b) Project Engineer $73/hr
   c) Design Engineer $73/hr
   d) Designer $61/hr
   e) Operators/HPTs $32/hr
   f) Site Construction $32/hr
   g) Admin. $28/hr

2. Overhead and profit rates for offsite procurement was figured at 18% for materials (incl. sales tax) and and 111% for onsite labor (see item 5 below). MPR rates for procurement was figured at 18.3%.

3. LLW disposal burial rates used were $15.29 per cubic foot (per WHC letter 9651554).

4. An efficiency reduction factor of 35% was employed to account for special work requirements associated with radiation work areas. This is based on engineering judgement and experience from past Hanford Installations.

5. Onsite construction forces general requirements, technical services, and craft overhead costs are included as a composite percentage based on the ICF-KH estimating factor, rev. 1, FY95, dated 1/18/94. The total composite percentage applied to onsite construction forces labor, for this project is 71% for shop work and 111% for field work, which is reflected in the Overhead/Profit column of the estimate detail.

6. Material costs for the sample conditioning system are based on a preliminary quote from the vendor for a similar item.

7. ECNs 635230, 625231, 625232, 625233, 624234, 625235, 625236 and 625237.

Contingency Analysis:

1. Engineering, Project management, and Other Project Costs were placed at 25% due to normal uncertainties in the tank farms.

2. Construction contingency was placed at 30% due to uncertainties with tank farm work such as: unknown contamination, unknown interferences, work stoppage due to weather, etc.

3. Procurement contingency was placed at 5% due to having a preliminary quote from a vendor for equipment without some of the custom features desired (such as adjustable dew point).

SHMS Gas Sample Conditioner

Estimate Details for Engineering

WBS	Activity	Quantity	Man Hours	Labor	Equipment/ Material	Overhead Profit	Total Cost
1.1	Engineering						
	Review ECNs	1 LS	60	$4,380.00	$0.00	$0.00	$4,380.00
	Prepare Work Packages	1 LS	120	$8,760.00	$0.00	$0.00	$8,760.00
	Prepare & Approve ATP/OTP	1 LS	80	$5,840.00	$0.00	$0.00	$5,840.00
	Prepare Plant Op. Procedure	1 LS	120	$8,760.00	$0.00	$0.00	$8,760.00
	Accecptance Inspection	1 LS	48	$8,760.00	$0.00	$0.00	$8,760.00
	Total WBS 1.1		368	$32,120.00	$0.00	$0.00	$36,500.00
	TOTAL 1.1		368	$32,120.00	$0.00	$0.00	$36,500.00

Note: Preparation of Plant Operating Procedure includes time for walk through with operations, reviews and approvals.

SHMS Gas Sample Conditioner

Estimate Details for Procurement

WBS	Activity	Quantity	Man Hours	Labor	Equipment/ Material	Subcontract	Total Cost
1.2	Procurement						
	Sample Conditioner	6 ea.	0	$0.00	$0.00	$115,500.00	$115,500.00
	Contract Administration	1 LS	200	$21,136.50	$0.00	$0.00	$21,136.50
	Review Vendor Submittals	1 LS	20	$1,460.00	$0.00	$0.00	$1,460.00
	Receipt Inspection	1 LS	12	$876.00	$0.00	$0.00	$876.00
	Total WBS 1.2		232	$23,472.50	$0.00	$115,500.00	$138,972.50
	Sales Tax (7.8%)						$9,009.00
	TOTAL 1.2		232	$23,472.50	$0.00	$115,500.00	$147,981.50

SHMS Gas Sample Conditioner

Construction Estimate Details (101-A)

WBS	Activity	Quantity	Man Hours	Labor	Equipment/ Material	Overhead Profit	Total Cost
1.3.1.1	Site Work						
	Deenergize and tagout equip.	1 LS	8	$256.00	$0.00	$284.16	$540.16
	Excavation	0.25 CY	4	$128.00	$0.00	$142.08	$270.08
	Place Footings	1 LS	8	$256.00	$200.00	$320.16	$776.16
	Total WBS 1.3.1.1		20	$640.00	$200.00	$746.40	$1,586.40
1.3.1.2	Install Cabinet/Tubing Connections						
	Install Unistrut	1 LS	4	$128.00	$376.00	$209.76	$713.76
	Install Cabinet	1 LS	4	$128.00	$10.00	$143.88	$281.88
	Install Tubing - 1/2 304L	8 LF	16	$512.00	$318.00	$625.56	$1,455.56
	Total WBS 1.3.1.2		24	$768.00	$704.00	$979.20	$2,451.20
1.3.1.3	Electrical						
	3/4" RGS Conduit	25 LF	16	$512.00	$60.00	$579.12	$1,151.12
	3C, 12 AWG, THHN	25 LF	8	$256.00	$6.00	$285.24	$547.24
	15 A, 1 pole, breaker	1 ea	8	$256.00	$43.00	$291.90	$590.90
	Add terminal blocks	1 LS	8	$256.00	$12.00	$286.32	$554.32
	Total WBS 1.3.1.3		40	$1,280.00	$121.00	$1,442.58	$2,843.58
1.3.1.4	Waste Disposal						
	Excavation dirt - LLW	0.2 CY	4	$128.00	$76.45	$155.84	$360.29
	Dispose of LLW const. matls	2 CF	4	$128.00	$45.87	$150.34	$324.21
	Total WBS 1.3.1.4		8	$256.00	$122.32	$306.18	$684.50
	SUB TOTAL 1.3.1		92	$2,944.00	$1,147.32	$3,474.36	$7,565.68
	35% adder for SWP Work		32	$1,030.40	$0.00	$1,143.74	$2,174.14
	SUB TOTAL 1.3.1		124	$3,974.40	$1,147.32	$4,618.10	$9,739.82
	30% adder for Const. Suppor		37	$2,719.98	$0.00	$0.00	$2,719.98
	Total 1.3.1		161	$6,694.38	$1,147.32	$4,618.10	$12,459.80

SHMS Gas Sample Conditioner

Construction Estimate Details (101-AX)

WBS	Activity	Quantity	Man Hours	Labor	Equipment/ Material	Overhead Profit	Total Cost
1.3.2.1	Site Work						
	Deenergize and tagout equip.	1 LS	8	$256.00	$0.00	$284.16	$540.16
	Excavation	0.25 CY	4	$128.00	$0.00	$142.08	$270.08
	Place Footings	1 LS	8	$256.00	$200.00	$320.16	$776.16
	Total WBS 1.3.2.1		20	$640.00	$200.00	$746.40	$1,586.40
1.3.2.2	Install Cabinet/Tubing Connections						
	Install Unistrut	1 LS	4	$128.00	$376.00	$209.76	$713.76
	Install Cabinet	1 LS	4	$128.00	$10.00	$143.88	$281.88
	Install Tubing - 1/2 304L	8 LF	16	$512.00	$318.00	$625.56	$1,455.56
	Total WBS 1.3.2.2		24	$768.00	$704.00	$979.20	$2,451.20
1.3.2.3	Electrical						
	3/4" RGS Conduit	35 LF	16	$512.00	$70.00	$580.92	$1,162.92
	3C, 12 AWG, THHN	35 LF	8	$256.00	$8.00	$285.60	$549.60
	15 A, 1 pole, breaker	1 ea	8	$256.00	$43.00	$291.90	$590.90
	Add terminal blocks	1 LS	8	$256.00	$12.00	$286.32	$554.32
	Total WBS 1.3.2.3		40	$1,280.00	$133.00	$1,444.74	$2,857.74
1.3.2.4	Waste Disposal						
	Excavation dirt - LLW	0.2 CY	4	$128.00	$76.45	$155.84	$360.29
	Dispose of LLW const. matls	2 CF	4	$128.00	$45.87	$150.34	$324.21
	Total WBS 1.3.2.4		8	$256.00	$122.32	$306.18	$684.50
	SUB TOTAL 1.3.2		92	$2,944.00	$1,159.32	$3,476.52	$7,579.84
	35% adder for SWP Work		32	$1,030.40	$0.00	$1,143.74	$2,174.14
	SUB TOTAL 1.3.2		124	$3,974.40	$1,159.32	$4,620.26	$9,753.98
	30% adder for Const. Suppor		37	$2,719.98	$0.00	$0.00	$2,719.98
	Total 1.3.2		161	$6,694.38	$1,159.32	$4,620.26	$12,473.96

SHMS Gas Sample Conditioner
Construction Estimate Details (106-C)

WBS	Activity	Quantity	Man Hours	Labor	Equipment/ Material	Overhead Profit	Total Cost
1.3.3.1	Site Work						
	Deenergize and tagout equip.	1 LS	8	$256.00	$0.00	$284.16	$540.16
	Excavation	0.25 CY	4	$128.00	$0.00	$142.08	$270.08
	Place Footings	1 LS	8	$256.00	$200.00	$320.16	$776.16
	Total WBS 1.3.3.1		20	$640.00	$200.00	$746.40	$1,586.40
1.3.3.2	Install Cabinet/Tubing Connections						
	Install Unistrut	1 LS	4	$128.00	$376.00	$209.76	$713.76
	Install Cabinet	1 LS	4	$128.00	$10.00	$143.88	$281.88
	Install Tubing - 1/2 304L	8 LF	16	$512.00	$318.00	$625.56	$1,455.56
	Total WBS 1.3.3.2		24	$768.00	$704.00	$979.20	$2,451.20
1.3.3.3	Electrical						
	3/4" RGS Conduit	25 LF	16	$512.00	$60.00	$579.12	$1,151.12
	3C, 12 AWG, THHN	25 LF	8	$256.00	$6.00	$285.24	$547.24
	15 A, 1 pole, breaker	1 ea	8	$256.00	$43.00	$291.90	$590.90
	Add terminal blocks	1 LS	8	$256.00	$12.00	$286.32	$554.32
	Total WBS 1.3.3.3		40	$1,280.00	$121.00	$1,442.58	$2,843.58
1.3.3.4	Waste Disposal						
	Excavation dirt - LLW	0.2 CY	4	$128.00	$76.45	$155.84	$360.29
	Dispose of LLW const. matls	2 CF	4	$128.00	$45.87	$150.34	$324.21
	Total WBS 1.3.3.4		8	$256.00	$122.32	$306.18	$684.50
	SUB TOTAL 1.3.3		92	$2,944.00	$1,147.32	$3,474.36	$7,565.68
	35% adder for SWP Work		32	$1,030.40	$0.00	$1,143.74	$2,174.14
	SUB TOTAL 1.3.3		124	$3,974.40	$1,147.32	$4,618.10	$9,739.82
	30% adder for Const. Suppor		37	$2,719.98	$0.00	$0.00	$2,719.98
	Total 1.3.3		161	$6,694.38	$1,147.32	$4,618.10	$12,459.80

SHMS Gas Sample Conditioner

Construction Estimate Details (102-S)

WBS	Activity	Quantity	Man Hours	Labor	Equipment/ Material	Overhead Profit	Total Cost
1.3.4.1	Site Work						
	Deenergize and tagout equip.	1 LS	8	$256.00	$0.00	$284.16	$540.16
	Excavation	2.4 CY	16	$512.00	$0.00	$568.32	$1,080.32
	Place Footings	1 LS	8	$256.00	$200.00	$320.16	$776.16
	Total WBS 1.3.4.1		32	$1,024.00	$200.00	$1,172.64	$2,396.64
1.3.4.2	Install Cabinet/Tubing Connections						
	Install Unistrut	1 LS	4	$128.00	$376.00	$209.76	$713.76
	Install Cabinet	1 LS	4	$128.00	$10.00	$143.88	$281.88
	Install Tubing - 1/2 304L	8 LF	16	$512.00	$318.00	$625.56	$1,455.56
	Total WBS 1.3.4.2		24	$768.00	$704.00	$979.20	$2,451.20
1.3.4.3	Electrical						
	3/4" RGS Conduit	30 LF	16	$512.00	$60.00	$579.12	$1,151.12
	3C, 12 AWG, THHN	30 LF	8	$256.00	$6.00	$285.24	$547.24
	15 A, 1 pole, breaker	1 ea	8	$256.00	$43.00	$291.90	$590.90
	Add terminal blocks	1 LS	8	$256.00	$12.00	$286.32	$554.32
	Total WBS 1.3.4.3		40	$1,280.00	$121.00	$1,442.58	$2,843.58
1.3.4.4	Waste Disposal						
	Excavation dirt - LLW	0.2 CY	4	$128.00	$76.45	$155.84	$360.29
	Dispose of LLW const. matls	2 CF	4	$128.00	$45.87	$150.34	$324.21
	Total WBS 1.3.4.4		8	$256.00	$122.32	$306.18	$684.50
	SUB TOTAL 1.3.4		104	$3,328.00	$1,147.32	$3,900.60	$8,375.92
	35% adder for SWP Work		36	$1,164.80	$0.00	$1,292.93	$2,457.73
	SUB TOTAL 1.3.4		140	$4,492.80	$1,147.32	$5,193.53	$10,833.65
	30% adder for Const. Suppor		42	$3,074.76	$0.00	$0.00	$3,074.76
	Total 1.3.4		183	$7,567.56	$1,147.32	$5,193.53	$13,908.41

SHMS Gas Sample Conditioner

Construction Estimate Details (102-SX)

WBS	Activity	Quantity	Man Hours	Labor	Equipment/ Material	Overhead Profit	Total Cost
1.3.5.1	Site Work						
	Deenergize and tagout equip.	1 LS	8	$256.00	$0.00	$284.16	$540.16
	Excavation	0.25 CY	4	$128.00	$0.00	$142.08	$270.08
	Place Footings	1 LS	8	$256.00	$200.00	$320.16	$776.16
	Total WBS 1.3.5.1		20	$640.00	$200.00	$746.40	$1,586.40
1.3.5.2	Install Cabinet/Tubing Connections						
	Install Unistrut	1 LS	4	$128.00	$376.00	$209.76	$713.76
	Install Cabinet	1 LS	4	$128.00	$10.00	$143.88	$281.88
	Install Tubing - 1/2 304L	8 LF	16	$512.00	$318.00	$625.56	$1,455.56
	Total WBS 1.3.5.2		24	$768.00	$704.00	$979.20	$2,451.20
1.3.5.3	Electrical						
	3/4" RGS Conduit	8 LF	12	$384.00	$35.00	$432.54	$851.54
	3C, 12 AWG, THHN	8 LF	8	$256.00	$6.00	$285.24	$547.24
	15 A, 1 pole, breaker	1 ea	8	$256.00	$43.00	$291.90	$590.90
	Add terminal blocks	1 LS	8	$256.00	$12.00	$286.32	$554.32
	Total WBS 1.3.5.3		36	$1,152.00	$96.00	$1,296.00	$2,544.00
1.3.5.4	Waste Disposal						
	Excavation dirt - LLW	0.2 CY	4	$128.00	$76.45	$155.84	$360.29
	Dispose of LLW const. matls	2 CF	4	$128.00	$45.87	$150.34	$324.21
	Total WBS 1.3.5.4		8	$256.00	$122.32	$306.18	$684.50
	SUB TOTAL 1.3.5		88	$2,816.00	$1,122.32	$3,327.78	$7,266.10
	35% adder for SWP Work		31	$985.60	$0.00	$1,094.02	$2,079.62
	SUB TOTAL 1.3.5		119	$3,801.60	$1,122.32	$4,421.79	$9,345.71
	30% adder for Const. Suppor		36	$2,601.72	$0.00	$0.00	$2,601.72
	Total 1.3.5		154	$6,403.32	$1,122.32	$4,421.79	$11,947.43

SHMS Gas Sample Conditioner

Construction Estimate Details (103-U)

WBS	Activity	Quantity	Man Hours	Labor	Equipment/ Material	Overhead Profit	Total Cost
1.3.6.1	Site Work						
	Deenergize and tagout equip.	1 LS	8	$256.00	$0.00	$284.16	$540.16
	Excavation	1 CY	12	$384.00	$0.00	$426.24	$810.24
	Place Footings	1 LS	8	$256.00	$200.00	$320.16	$776.16
	Total WBS 1.3.6.1		28	$896.00	$200.00	$1,030.56	$2,126.56
1.3.6.2	Install Cabinet/Tubing Connections						
	Install Unistrut	1 LS	4	$128.00	$376.00	$209.76	$713.76
	Install Cabinet	1 LS	4	$128.00	$10.00	$143.88	$281.88
	Install Tubing - 1/2 304L	8 LF	16	$512.00	$318.00	$625.56	$1,455.56
	Total WBS 1.3.6.2		24	$768.00	$704.00	$979.20	$2,451.20
1.3.6.3	Electrical						
	3/4" RGS Conduit	20 LF	16	$512.00	$60.00	$579.12	$1,151.12
	3C, 12 AWG, THHN	20 LF	8	$256.00	$6.00	$285.24	$547.24
	15 A, 1 pole, breaker	1 ea	8	$256.00	$43.00	$291.90	$590.90
	Add terminal blocks	1 LS	8	$256.00	$12.00	$286.32	$554.32
	Total WBS 1.3.6.3		40	$1,280.00	$121.00	$1,442.58	$2,843.58
1.3.6.4	Waste Disposal						
	Excavation dirt - LLW	0.2 CY	4	$128.00	$76.45	$155.84	$360.29
	Dispose of LLW const. matls	2 CF	4	$128.00	$45.87	$150.34	$324.21
	Total WBS 1.3.6.4		8	$256.00	$122.32	$306.18	$684.50
	SUB TOTAL 1.3.6		100	$3,200.00	$1,147.32	$3,758.52	$8,105.84
	35% adder for SWP Work		35	$1,120.00	$0.00	$1,243.20	$2,363.20
	SUB TOTAL 1.3.6		135	$4,320.00	$1,147.32	$5,001.72	$10,469.04
	30% adder for Const. Suppor		41	$2,956.50	$0.00	$0.00	$2,956.50
	Total 1.3.6		176	$7,276.50	$1,147.32	$5,001.72	$13,425.54
	Grand Total 1.3		997	$41,330.52	$6,870.92	$28,473.50	$76,674.94

SHMS Gas Sample Conditioner

Estimate Details for Project Management

WBS	Activity	Quantity	Man Hours	Labor	Equipment/ Material	Overhead Profit	Total Cost
1.4	Project Management						
	Project Manager	1 LS	20	$1,460.00	$0.00	$0.00	$1,460.00
	Project Engineer	1 LS	80	$5,840.00	$0.00	$0.00	$5,840.00
	Safety Support	1 LS	20	$1,460.00	$0.00	$0.00	$1,460.00
	QA Support	1 LS	20	$1,460.00	$0.00	$0.00	$1,460.00
	Admin Support	1 LS	32	$896.00	$0.00	$0.00	$896.00
	Design Authority Review	1 LS	20	$1,460.00	$0.00	$0.00	$1,460.00
	Revise SAR/ISB/SEL	1 LS	40	$2,920.00	$0.00	$0.00	$2,920.00
	Total WBS 1.4			$15,496.00	$0.00	$0.00	$15,496.00
	TOTAL 1.4		0	$15,496.00	$0.00	$0.00	$15,496.00

SHMS Gas Sample Conditioner

Estimate Details for Startup

WBS	Activity	Quantity	Man Hours	Labor	Equipment/ Material	Overhead Profit	Total Cost
1.5	Startup						
	Conduct ATP/OTP	1 LS	48	$3,408.00	$0.00	$0.00	$3,408.00
	Place in Operation	1 LS	24	$1,704.00	$0.00	$0.00	$1,704.00
	Total WBS 1.5		72	$5,112.00	$0.00	$0.00	$5,112.00
	TOTAL 1.5		72	$5,112.00	$0.00	$0.00	$5,112.00

Appendix D
Data Logger ECN

ENGINEERING CHANGE NOTICE

Page 1 of 10

1. ECN Nº 625239

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	3a. USQ Required?	4. Date
Supplemental [X] Direct Revision [] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	BD Groth, ARES Corporation, Richland, WA 946-3300	[X] Yes [] No	8/2/96
	5. Project Title/No./Work Order No. SHMS Data Acquisition/ N2165	6. Bldg./Sys./Fac. No. 241-General	7. Approval Designator SQ
	8. Document Numbers Changed by this ECN (includes sheet no. and rev.) See Block 12	9. Related ECN No(s). None	10. Related PO No. N/A

11a. Modification Work	11b. Work Package No.	11c. Modification Work Complete	11d. Restored to Original Condition (Temp. or Standby ECN only)
[X] Yes (fill out Blk. 11b) [] No (NA Blks. 11b, 11c, 11d)		Cog. Engineer Signature & Date	N/A Cog. Engineer Signature & Date

12. Description of Change

Design Basline Document - No
Engineering Task Number: ETN-94-0002

8. Document Numbers Changed by this ECN

H-2-817853, sh. 1, rev. 1
H-2-817853, sh. 2, rev. 1
H-2-817854, sh. 1, rev. 1
H-2-817854, sh. 2, rev. 1
H-2-87275, sh. 1, rev. 1
H-2-822775, sh. 1, rev. 1
H-2-822775, sh. 2, rev. 0
H-2-822775, sh. 4, rev. 1
H-2-822776, sh. 1, rev. 0
H-2-822776, sh. 2, rev. 0

This ECN provides installation design in order to install a digital data logger in place of the strip chart recorder on selected SHMS systems.

13a. Justification (mark one)

Criteria Change	[]	Design Improvement	[X]	Environmental	[]	Facility Deactivation	[]
As-Found	[]	Facilitate Const	[]	Const. Error/Omission	[X]	Design Error/Omission	[]

13b. Justification Details

Use of the SHMS system in farms without TMACS requires manually inputting data from the strip chart into spreadsheets for data analysis. This process is time consuming and not cost effective. The use of a data logger will rectify this problem.

14. Distribution (include name, MSIN, and no. of copies)

DB Engelman	L6-37 (1)	DT Lott	R3-25 (1)
JM Jones	S5-13 (1)	CC Scaief	S2-01 (1)
TC Schneider	L6-37 (1)	CV Vo	L6-37 (1)
DD Tate	L6-37 (1)	RE Raymond	S7-12 (1)
HW Henrikson	R3-28 (1)		
Tank Farm Information Center	R1-28 (1)		

RELEASE STAMP

A-7900-013-2 (11/94) GEF095

A-7900-013-1

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1) 625239

15. Design Verification Required	16. Cost Impact				17. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[ ] Yes	Additional	[X] $4K	Additional	[X] $8K	Improvement	[ ] N/A
[X] No	Savings	[ ] $	Savings	[ ] $	Delay	[ ] N/A

18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

SDD/DD	[X]	Seismic/Stress Analysis	[ ]	Tank Calibration Manual	[ ]
Functional Design Criteria	[ ]	Stress/Design Report	[ ]	Health Physics Procedure	[ ]
Operating Specification	[ ]	Interface Control Drawing	[ ]	Spares Multiple Unit Listing	[ ]
Criticality Specification	[ ]	Calibration Procedure	[ ]	Test Procedures/Specification	[ ]
Conceptual Design Report	[ ]	Installation Procedure	[ ]	Component Index	[ ]
Equipment Spec.	[ ]	Maintenance Procedure	[ ]	ASME Coded Item	[ ]
Const. Spec.	[ ]	Engineering Procedure	[ ]	Human Factor Consideration	[ ]
Procurement Spec.	[ ]	Operating Instruction	[ ]	Computer Software	[ ]
Vendor Information	[ ]	Operating Procedure	[ ]	Electric Circuit Schedule	[ ]
OM Manual	[ ]	Operational Safety Requirement	[ ]	ICRS Procedure	[ ]
FSAR/SAR	[ ]	IEFD Drawing	[ ]	Process Control Manual/Plan	[ ]
Safety Equipment List	[ ]	Cell Arrangement Drawing	[ ]	Process Flow Chart	[ ]
Radiation Work Permit	[ ]	Essential Material Specification	[ ]	Purchase Requisition	[ ]
Environmental Impact Statement	[ ]	Fac. Proc. Samp. Schedule	[ ]	Tickler File	[ ]
Environmental Report	[ ]	Inspection Plan	[ ]	None	[ ]
Environmental Permit	[ ]	Inventory Adjustment Request	[ ]		[ ]

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
N/A		

20. Approvals

Signature	Date	Signature	Date
OPERATIONS AND ENGINEERING		ARCHITECT-ENGINEER	
Cog. Eng. TC Schneider		~~DE~~ RL Fritz Proj Mgr RLF	8/16-96
Cog. Mgr. DB Engelman		QA	
QA HW Henrikson		Safety	
Safety		Design BD Groth BD Groth	8/15-96
Environ.		Environ.	
Other DT Lott		Other	
CC Scaief			
DD Tate			
JM Jones		DEPARTMENT OF ENERGY	
		Signature or a Control Number that tracks the Approval Signature	
		ADDITIONAL	

This ECN replaces the Strip Chart Recorder on selected SHMS that do not have access to TMACS with a standalone Data Logger to allow for improved data handling and analysis. This modification will allow data to be downloaded directly into spreadsheets and other analysis software, as opposed to the manual data entry necessary with the Strip Chart Recorder.

Add to Drawing H-2-87275, rev. 1, sh. 1

Add the following column to the STANDARD HYDROGEN MONITOR (SHMS) TABLE

Tank Farm	Tank Number	Stand Alone Data Logger ECN (when installed)
A	101	625239
AN	103 104 105	
AW	101	625239
AX	101 103	625239 625239
S	102 111 112	
SX	101 102 103 104 105 106 109	
SY	101 103	
T	110	
U	103 105 107 108 109	

ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-817853	1	1	ECN No. 625239	4 OF 12

ADD PART No. 27 AS FOLLOWS:

PARTS LIST

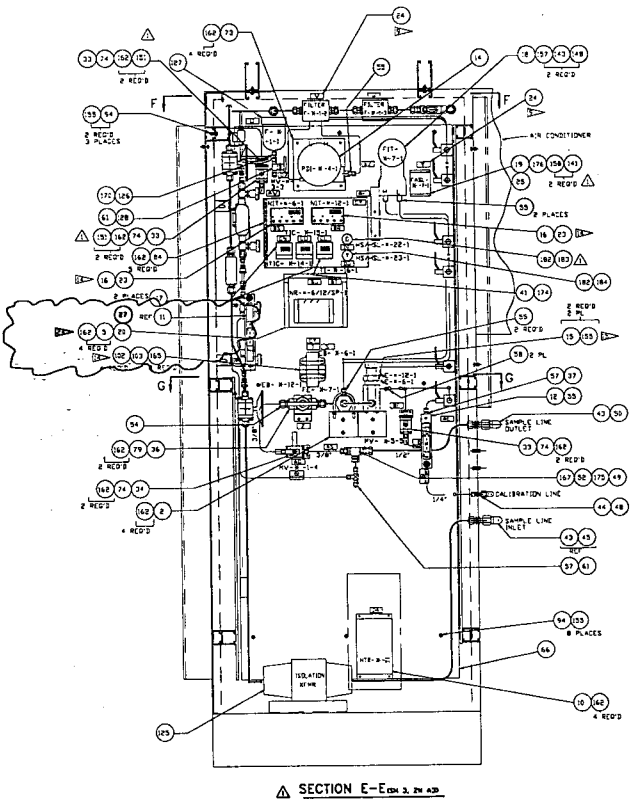
24					1	NR- X -6/12-1	4153-555-32/BU /A4-04/REM/S25N1	RECORDER, 3 PEN	YOKOGAWA		20
					1	YAL- X -18-1	94A-N5	STROBE LIGHT, HEAVY DUTY (AMBER)	EDWARDS DIV. FARMINGTON, CT.		21
					1	YAL- X -10-1	94R-N5	STROBE LIGHT, HEAVY DUTY (RED)	EDWARDS DIV. FARMINGTON, CT.	3	22
					2		RN-55C	1/4 WATT METAL FILM RESISTOR, 40.2k ohm, 1%	MIL OR EQUAL	4	23
9					AR			NAMEPLATE, (SEE N.P. LEGEND)	(HPS-1-2-7)	3,4, 5	24
1					1		M801	RETAINING SPRING	ACTION INSTRUMENTS	4	25
											26
24					1	NR-*-6/12-1	SVC-300-10-21-011-0	SMART VIEW DATA LOGGER	WESTRONICS	4	27
1					1	YYC- X -01	315-AA	PROGRAMMABLE LOGIC CONTROLLER	TEXAS INSTRUMENT	5	28
					1	PI- * -8-1	45.740-30"Hg-1/4"NPT	VACUUM PRESSURE GAUGE	NOSHOK INC	5	29
					1	PWR- X -01	VA24MT210	POWER SUPPLY, 24VDC SERIES A	ACOPIAN	5	30

ADD NOTES 24 AS FOLLOWS:

GENERAL NOTES

24 OPTION FOR EITHER P/N 20 OR 27. REFER TO H-2-87275 FOR INFORMATION ON INDIVIDUAL UNITS.

ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-822775	4	1	ECN No. 625239	5 OF 12



SECTION E-E

(STANDARD HYDROGEN MONITORING SYSTEM)

ARES Corporation			ENGINEERING CHANGE NOTICE SKETCH	
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-817854	1	1	ECN No. 625239	6 OF 12

ADD NOTE 13 AS FOLLOWS:

GENERAL NOTES

8. INTRINSIC SAFETY GROUNDING SHALL BE INSTALLED AND TESTED IN ACCORDANCE WITH NFPA-70 1993 SECTION 504-50 AND ANSE/ISA RP 12.6-1987

9. MULTIPLE LUGS ON A SINGLE TERMINAL WILL BE LANDED BACK TO BACK.

10. TERMINATION TITLES INCLUDE "TO" INFORMATION PLUS THE WIRE NUMBER IN PARENTHESIS.
EXAMPLES ARE:

BY-*-10-1 (FU-9H)

DEVICE AND/OR TB WIRE #

11. INSTALLATION SHALL CONFORM TO THE NEC-1993 EDITION.

12. PROVIDE CERTIFICATION OF TESTING 100% OF INSTALLED WIRING AS VERIFIED BY THE PERFORMING CRAFT. TEST WIRING FOR CONTINUITY (MAXIMUM 1 OHM) AND UNINTENTIONAL SHORTS (MINIMUM 200 MEGOHMS) WITH CALIBRATED TEST INSTRUMENTS CERTIFIED TRACEABLE TO NIST STANDARD. REPAIR ALL VARIANCES.

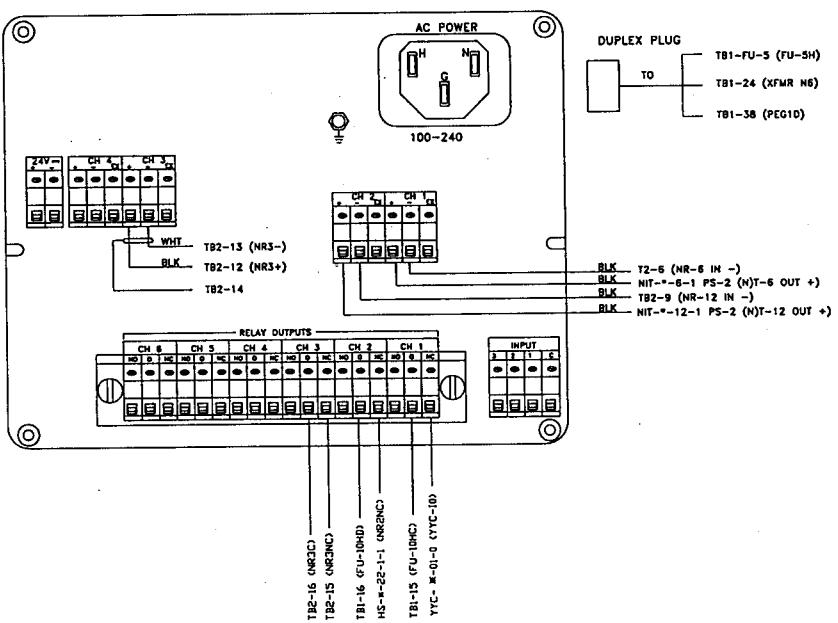
13> NR-*-6/12/SP-1 HAS AN OPTION OF STRIP CHART RECORDER OR DATA LOGGER. REFER TO H-2-87275.

ARES Corporation			ENGINEERING CHANGE NOTICE SKETCH	
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-817854	2	1	ECN No. 625239	7 OF 12

NR-*-6-1
NR-*-12-1
NR-*-SP-1

NR-*-6-1 = CHANNEL 1
NR-*-12-1 = CHAANNEL 2
NR-*-SP-1 = CHANNEL 3

OR WITH DATA LOGGER OPTION 13



(STANDARD HYDROGEN MONITORING SYSTEM)

ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-822775	1	1	ECN No. 625239	8 OF 12

ADD FLAG TO PART No. 20 AS FOLLOWS:

PARTS LIST

26					1	NR- X -6/12-1	4153-555-32/BU /AK-04/REM/S25N1	RECORDER, 3 PEN	YOKOGAWA	4	20

ADD NOTE 26 AS FOLLOWS

GENERAL NOTES

26 OPTION FOR EITHER P/N 20 OR 222. REFER TO H-2-87275 FOR INFORMATION ON INDIVIDUAL UNITS.

ARES Corporation	ENGINEERING CHANGE NOTICE SKETCH			
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-822775	2	0	ECN No. 625239	9 OF 12

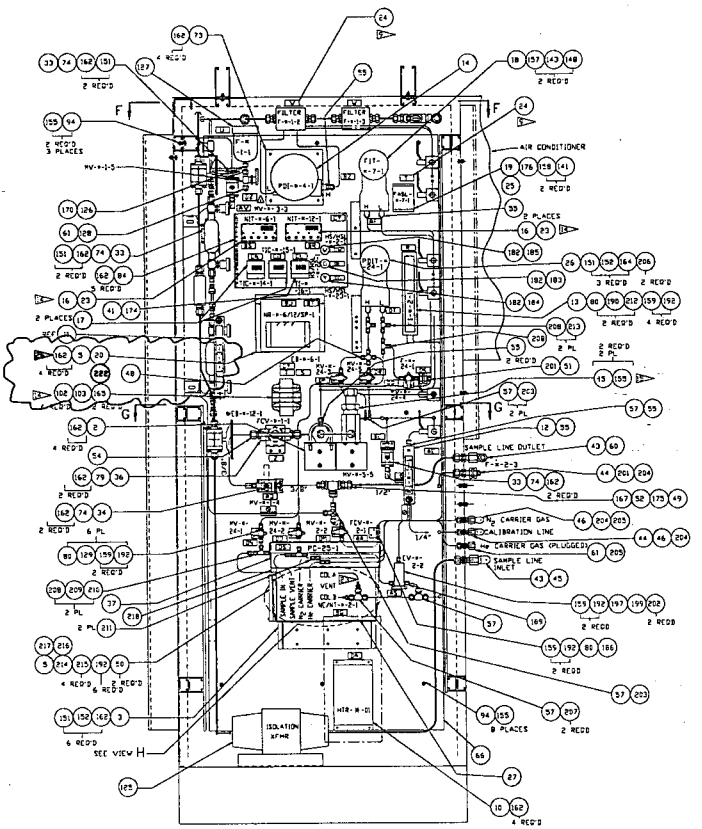
ADD PART No. 222 AS FOLLOWS:

PARTS LIST

					1			NYLON TIE STRAP, 1" WIDE	ANY GRADE	7.4	218
					1	EV-*-5-1	B2DA1175	2-WAY N.C. SOLENOID VALVE, 120 VAC COIL	HONEYWELL/ SKINNER	5	219
					1	F-*-2-1	101-002-SS	MEMBRANE MOISTURE SEPARATION FILTER	A+ CORPORATION	5	220
					1		101-S09SS	MEMBRANE FILTER MOUNTING BRACKET	A+ CORPORATION	5	221
26					1	NR-*-6/ 12-1	SVC-300-10-21-011-0	SMARTVIEW DATA LOGGER	WESTRONICS	4	222

ARES Corporation			ENGINEERING CHANGE NOTICE SKETCH	
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-822775	4	1	ECN No. 62539	10 OF 12

ADD PART No. 222 AS FOLLOWS:



SECTION E-E ITEM 3, IN A3D
SCALE: 1/4

ARES Corporation			ENGINEERING CHANGE NOTICE SKETCH	
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-822776	1	0	ECN No. 625239	11 OF 12

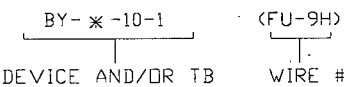
ADD NOTE 13 AS FOLLOWS:

GENERAL NOTES

8. INTRINSIC SAFETY GROUNDING SHALL BE INSTALLED AND TESTED IN ACCORDANCE WITH NFPA-70 1993 SECTION 504-50 AND ANSE/ISA RP 12.6-1987

9. MULTIPLE LUGS ON A SINGLE TERMINAL WILL BE LANDED BACK TO BACK.

10. TERMINATION TITLES INCLUDE "TO" INFORMATION PLUS THE WIRE NUMBER IN PARENTHESIS.
EXAMPLES ARE:



11. INSTALLATION SHALL CONFORM TO THE NEC-1993 EDITION.

12. PROVIDE CERTIFICATION OF TESTING 100% OF INSTALLED WIRING AS VERIFIED BY THE PERFORMING CRAFT. TEST WIRING FOR CONTINUITY (MAXIMUM 1 OHM) AND UNINTENTIONAL SHORTS (MINIMUM 200 MEGOHMS) WITH CALIBRATED TEST INSTRUMENTS CERTIFIED TRACEABLE TO NIST STANDARD. REPAIR ALL VARIANCES.

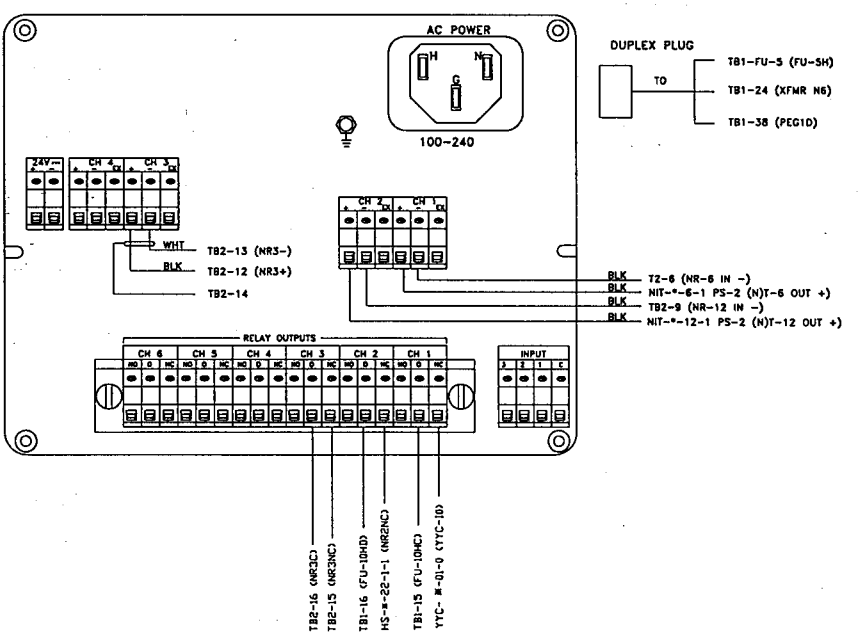
13> NR-*-6/12/SP-1 HAS AND OPTION OF STRIP CHART RECORDER OR DATA LOGGER. REFER TO H-2-87275

ARES Corporation			ENGINEERING CHANGE NOTICE SKETCH	
REFERENCE DRAWING	SH.	REV.	PREPARED BY: B.GROTH	PAGE
H-2-822776	2	0	ECN No. 625239	12 OF 12

NR-*-6-1
NR-*-12-1
NR-*-SP-1

NR-*-6-1 = CHANNEL 1
NR-*-12-1 = CHAANNEL 2
NR-*-SP-1 = CHANNEL 3

OR WITH DATA LOGGER OPTION 13



(STANDARD HYDROGEN MONITORING SYSTEM)

Appendix E
Data Logger Cost Estimate

SHMS Data Logger
Estimate Summary

WBS	Activity	Estimate Subtotal	Escalation %	Escalation Total	Subtotal	Contingency %	Contingency Total	Total Dollars
1.1	Engineering	$19,856	0.0%	$0	$19,856	25.0%	$4,964	$24,820
1.2	Procurement	$17,723	0.0%	$0	$17,723	5.0%	$886	$18,609
1.3	Construction	$7,331	0.0%	$0	$7,331	30.0%	$2,199	$9,531
1.4	Project Management	$5,098	0.0%	$0	$5,098	25.0%	$1,275	$6,373
1.5	Startup	$3,408.00	0.0%	$0	$3,408	25.0%	$852	$4,260
TOTAL		$53,416	0.0%	$0	$53,416	19.1%	$10,176	**$63,592**

Estimate Basis:

1. General labor rates for onsite work are based on WHC rates utilized for previous coneceptual designs and are as follows:
   a) Project Manager $76/hr
   b) Project Engineer $73/hr
   c) Design Engineer $73/hr
   d) Designer $61/hr
   e) Operators/HPTs $32/hr
   f) Site Construction $32/hr
   g) Admin. $28/hr

2. Overhead and profit rates for offsite procurement was figured at 18% for materials (incl. sales tax) and and 111% for onsite labor (see item 5 below). MPR rate of 18.3% was used for procurements.

3. An efficiency reduction factor of 35% was employed to account for special work requirements associated with radiation work areas. This is based on engineering judgement and experience.

4. Onsite construction forces general requirements, technical services, and craft overhead costs are included as a composite percentage based on the ICF-KH estimating factor, rev. 1, FY95, dated 1/18/94. The total composite percentage applied to onsite construction forces labor, for this project is 71% for shop work and 111% for field work, which is reflected in the Overhead/Profit column of the estimate detail.

5. Material costs for the sample conditioning system are based on a preliminary quote from the vendor for a similar item.

6. ECN 635239

Contingency Analysis:

1. Engineering, Project management, and Other Project Costs were placed at 25% due to normal uncertainties in the tank farms.

2. Construction contingency was placed at 30% due to uncertainties with tank farm work such as: unknown contamination, unknown interferences, work stoppage due to weather, etc.

3. Procurement contingency was placed at 5% due to having procured one test model earlier.

SHMS Data Logger

Estimate Details for Engineering

WBS	Activity	Quantity	Man Hours	Labor	Equipment/ Material	Overhead Profit	Total Cost
1.1	Engineering						
	Prepare Work Packages	1 LS	80	$5,840.00	$0.00	$0.00	$5,840.00
	Prepare & Approve ATP/OTP	1 LS	32	$2,336.00	$0.00	$0.00	$2,336.00
	Prepare Plant Op. Procedure	1 LS	80	$5,840.00	$0.00	$0.00	$5,840.00
	Acceptance Inspection	1 LS	32	$5,840.00	$0.00	$0.00	$5,840.00
	Total WBS 1.1		224	$19,856.00	$0.00	$0.00	$19,856.00
	TOTAL 1.1		224	$19,856.00	$0.00	$0.00	$19,856.00

Note: Preparation of Plant Operating Procedure includes time for walk through with operations, reviews and approvals.

SHMS Data Logger

Estimate Details for Procurement

WBS	Activity	Quantity	Man Hours	Labor	Equipment/ Material	Subcontract	Total Cost
1.2	Procurement						
	Data Logger	4 ea.	0	$0.00	$0.00	$13,360.00	$13,360.00
	Contract Administration	1 LS	36	$2,444.88	$0.00	$0.00	$2,444.88
	Receipt Inspection	1 LS	12	$876.00	$0.00	$0.00	$876.00
	Total WBS 1.2		48	$3,320.88	$0.00	$13,360.00	$16,680.88
	Sales Tax (7.8%)						$1,042.08
	TOTAL 1.2		48	$3,320.88	$0.00	$13,360.00	$17,722.96

SHMS Data Logger

Construction Estimate Details

WBS	Activity	Quantity	Man Hours	Labor	Equipment/ Material	Overhead Profit	Total Cost
1.3.1.1	Site Work						
	Deenergize and tagout equip.	1 LS	8	$256.00	$0.00	$284.16	$540.16
	Total WBS 1.3.1.1		8	$256.00	$0.00	$284.16	$540.16
1.3.1.2	Shop Work						
	Program Data Logger	4 EA	16	$1,168.00	$62.00	$922.20	$2,152.20
	Total WBS 1.3.1.2		16	$1,168.00	$62.00	$922.20	$2,152.20
1.3.1.3	Electrical						
	Disconnect and remove strip chart recorder	4 EA	16	$512.00	$0.00	$568.32	$1,080.32
	Install data logger and connect	4 EA	16	$512.00	$0.00	$568.32	$1,080.32
	Total WBS 1.3.1.3		32	$1,024.00	$0.00	$1,136.64	$2,160.64
	SUB TOTAL 1.3.1		56	$2,448.00	$62.00	$2,343.00	$4,853.00
	35% adder for SWP Work		14	$448.00	$0.00	$497.28	$945.28
	SUB TOTAL 1.3.1		70	$2,896.00	$62.00	$2,840.28	$5,798.28
	30% adder for Const. Suppor		21	$1,533.00	$0.00	$0.00	$1,533.00
	Total 1.3.1		91	$4,429.00	$62.00	$2,840.28	$7,331.28

SHMS Data Logger

Estimate Details for Project Management

WBS	Activity	Quantity	Man Hours	Labor	Equipment/ Material	Overhead Profit	Total Cost
1.4	Project Management						
	Project Manager	1 LS	8	$584.00	$0.00	$0.00	$584.00
	Project Engineer	1 LS	32	$2,336.00	$0.00	$0.00	$2,336.00
	Safety Support	1 LS	2	$146.00	$0.00	$0.00	$146.00
	QA Support	1 LS	8	$584.00	$0.00	$0.00	$584.00
	Admin Support	1 LS	10	$280.00	$0.00	$0.00	$280.00
	Design Authority Review	1 LS	8	$584.00	$0.00	$0.00	$584.00
	Revise SAR/ISB/SEL	1 LS	8	$584.00	$0.00	$0.00	$584.00
	Total WBS 1.4		76	$5,098.00	$0.00	$0.00	$5,098.00
	TOTAL 1.4		76	$5,098.00	$0.00	$0.00	$5,098.00

SHMS Data Logger

Estimate Details for Startup

WBS	Activity	Quantity	Man Hours	Labor	Equipment/ Material	Overhead Profit	Total Cost
1.5	Startup						
	Conduct ATP/OTP	1 LS	32	$2,272.00	$0.00	$0.00	$2,272.00
	Place in Operation	1 LS	16	$1,136.00	$0.00	$0.00	$1,136.00
	Total WBS 1.5		48	$3,408.00	$0.00	$0.00	$3,408.00
	TOTAL 1.5		48	$3,408.00	$0.00	$0.00	$3,408.00

Appendix F
Water Accumulation Calculations

PROBLEM 1

Determine the amount of water that could be condensing in the SHMS cabinet sample line. Determine heat removal rate to condense the water.

- Data

  1. Lowest cabinet design temperature - 70° F. (WHC 1994)
  2. Volumetric gas flow rate (q) - 0.5 CFM (Schneider 1996)
  3. Heat Trace Setting 70° to 120° F. (WHC 1994)

- Assumptions

  1. Tank vapor is saturated. This is conservative because of the high salt content of the tanks. Also, actively ventilated tanks are not likely to be near saturation.
  2. Lowering the dew point to 60° F is adequate moisture removal because the cabinet is maintained between 70° and 90° F.
  3. Assume CFM of sample gas flow listed is at standard conditions.

- Solution

  Because it is desired to lower the dew point to 60° F, the moisture that could condense in the lines will be calculated at this point rather than the 70° F at the SHMS cabinet. Water condensation rate and required heat removal rate will be calculated for several temperatures between 120° and 200° F. The ideal design would be capable of handling a gas sample stream at 200° F, but it is realized that this may be overly conservative and require a fairly large system.

  From Perry (1984) the following data was obtained where:

H_s = the saturated humidity in lbs of H_20/lb of dry air
v_s = the specific volume of the air at saturated conditions
ΔH = the enthalpy change in BTU/lb

Temperature - deg. F	H_s	v_s
200	2.295	16.632
170	0.4327	15.874
150	0.2125	15.369
120	0.08149	14.611
60	0.01108	13.096
32 (standard conditions)	0.003788	12.388

This data is then used to determine the amount of water that could be removed per minute with the following equation.

Water removal rate (lb/min) = (q ft^3/min)*(H_{s1} $lb_{H2O}/lb_{dry\ air}$ - H_{s2} $lb_{H2O}/lb_{dry\ air}$)/(v_s at 32° F)

This is also used for determining the required heat transfer rate (Q) using values for the latent heat of vaporization (McCabe, 1993). Where:

Q (BTU/hr) = q*ΔH

The results are summarized in the table below.

q (ft^3/min)	Temp (deg. F)	Water Removal Rate (lb/min)	ΔH (BTU/lb)	Q (BTU/hr)
0.5	200	0.092	1117.8	6,170
0.5	170	0.017	1106.1	1,128
0.5	150	0.0057	1098.0	533
0.5	120	0.0031	1085.4	202

Because it is possible, although highly unlikely, that temperatures approaching 150° F could be seen in the sample line, this was chosen as a conservative and yet achievable design point. If we convert to watts:

533 BTU/hr = 156 watts

PROBLEM 2

Water saturated air with a small amount of ammonia enters a condenser at a temperature of 150° F and a flow rate of 0.5 SCFM. The air exits at 60° F under saturated conditions. Determine the maximum amount of ammonia that can be stripped.

- Assumptions

  This is essentially a gas absorption problem where the number of theoretical plates for the condenser (absorption tower) is unknown. If we assume an infinite number (very conservative) of theoretical plates, then the problem becomes a simple mass balance with the use of Henry's law to determine the solubility of the ammonia in water.

  Other assumptions/data:

  1. Ammonia concentrations are often seen in the range of 100-200 ppm (Schneider). Therefore a feed basis of 200 PPM ppm will be used.

  2. Henry's law data for ammonia was limited and a value for $K_i = y_i/x_i$ (where y_i is the ammonia concentration in the gas phase and x_i is the ammonia concentration in the liquid phase) was found to be 0.937 at 77° F. This information was used to

plot the equilibrium line of Figure 1.

- Solution

Let:

y_a = The ammonia gas mole fraction exiting the condenser.
y_b = The ammonia gas mole fraction entering the condenser.
x_a = The ammonia mole fraction of the water condensing at the top of the condenser (i.e. 0)
x_b = The ammonia mole fraction of the water at the bottom of the condenser as it exits.
L_a = The liquid molal flow at the top of the condenser
L_b = The liquid molal flow at the bottom of the condenser
V_a = The gas molal flow rate exiting the condenser
V_b = The gas molal flow rate entering the condenser

Treating the condenser as a gas absorption column the operating line would be described by the following equation (McCabe 1993).

$$y = \frac{L}{V}x + \frac{V_a y_a - L_a x_a}{V}$$

For determining the bounding condition, the above equation for the minimum operating line reduces to:

$$y = \frac{L}{V}x + y_a$$

Note that this is a slightly different application of this equation from its normal use in a gas absorption column in that the water that is being stripped out of the air is then being used to strip the ammonia out of the air. Since we are dealing with water percentages as high as 21 weight percent (13 mole percent) the L/V ratio will change appreciably, so the average L/V flow is used which will still provide somewhat conservative results. This is considered the minimum operating line and in reality, less ammonia will be stripped than is calculated by this method.

If we assume a 100 mole feed basis into the condenser we can calculate the appropriate mole fractions for the air water and ammonia exiting as a gas and in the condensate. The results of this are shown in Table 1 below and the equilibrium and operating curves are plotted in Figure 1.

Table 1

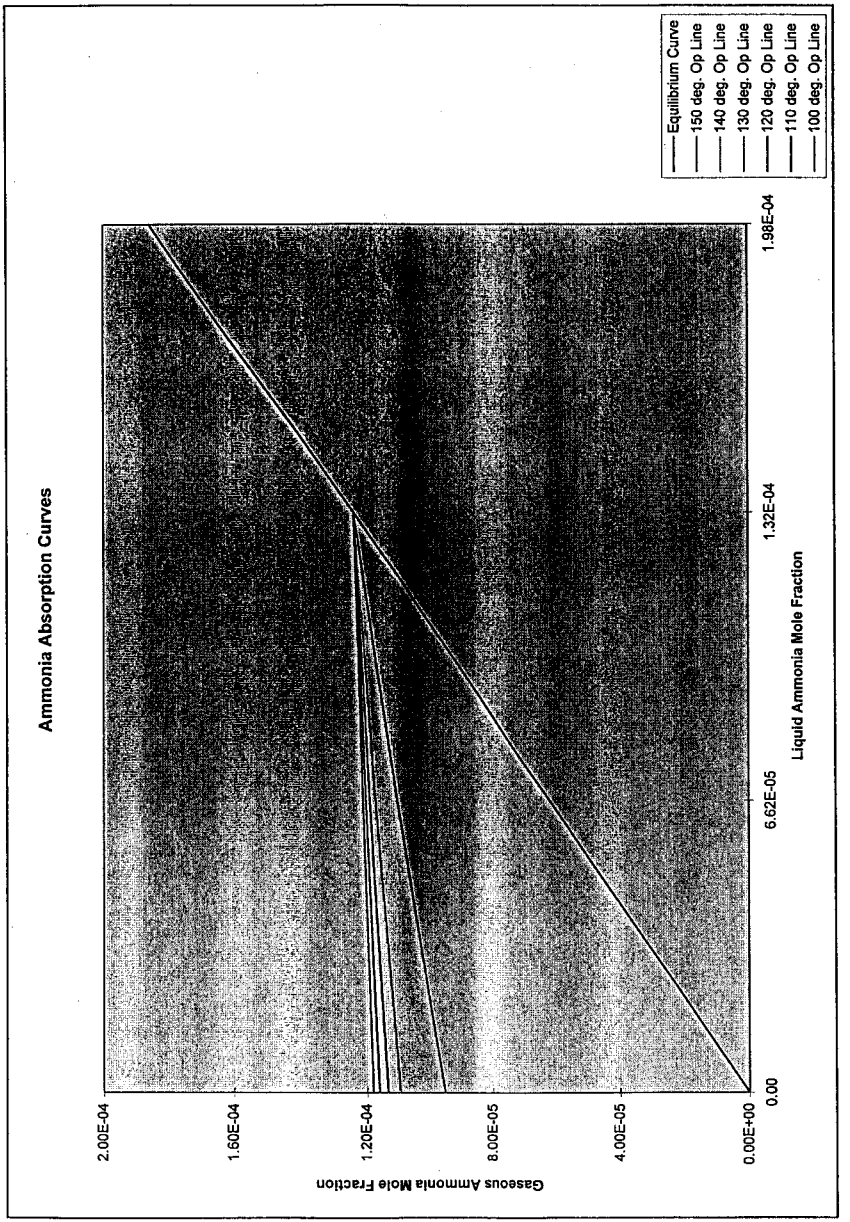
T (deg. F)	H_s	Moles - H_2O in	Moles - H_2O out	Average Molal Flow (H_2O)	L/V	y_b	y_a	% NH_3 loss
150	0.2125	34.2361	1.1761	17.7061	0.2152	1.24E-04	9.55E-05	20%
140	0.1534	24.7144	1.3464	13.0304	0.1498	1.24E-04	1.04E-04	13%
130	0.1116	17.9800	1.4668	9.7234	0.1077	1.24E-04	1.10E-04	9%
120	0.08149	13.1289	1.5535	7.3412	0.0792	1.24E-04	1.14E-04	5%
110	0.05944	9.5764	1.6171	5.5968	0.0593	1.24E-04	1.16E-04	3%
100	0.04319	6.9584	1.6639	4.3111	0.0451	1.24E-04	1.18E-04	2%

As can be seen, and as would be predicted, the amount of ammonia removed decreases with a reduction in the amount of water in the system. As stated previously, this is a bounding situation and the actual amount of ammonia removed would be somewhat less, and would depend on the design of the condenser. Since the condenser chosen is designed to minimize the contact of the liquid and gas streams, the results are considered conservative in that less ammonia is likely to be stripped from the gas stream than what was calculated.

REFERENCES

McCabe, W.L., J.C. Smith, and P. Harriott, *Unit Operations of Chemical Engineering*, Fifth Edition, McGraw-Hill Book Company, New York, New York.

Perry, R.H., and D.W. Green, 1984, *Perry's Chemical Engineers' Handbook*, Sixth Edition, McGraw-Hill Book Company, New York, New York.


Ammonia Absorption Curves
Gaseous Ammonia Mole Fraction
2.00E-04
1.60E-04
1.20E-04
8.00E-05
4.00E-05
0.00E+00
0.00
6.62E-05
1.32E-04
1.98E-04
Liquid Ammonia Mole Fraction
Equilibrium Curve
150 deg. Op Line
140 deg. Op Line
130 deg. Op Line
120 deg. Op Line
110 deg. Op Line
100 deg. Op Line

Appendix G
103-AX Green Substance Sample Results

VALIDATED RESULTS SHORT REPORT 10 Jul 1996

Customer ID: AX103
Lab Sample#: S96E000514
Sample Date:
Recv. Date: 05/01/96 10:24

PARAMETER	RESULTS	UNITS
Anions by IC-Dionex 4000i/4500		
Bromide by Ion Chromatograph	<1.383e+03	ug/g
Chloride-IC-Dionex 4000i/4500	1.770e+03	ug/g
Fluoride-IC-Dionex 4000i/4500	<1.427e+02	ug/g
Nitrate by IC-Dionex 4000i/4500	5.023e+05	ug/g
Nitrite-IC - Dionex 4000i/4500	<1.175e+03	ug/g
Oxalate by IC - Dionex 4000i	<1.153e+03	ug/g
Phosphate-IC-Dionex 4000i/4500	<1.305e+03	ug/g
Sulfate by IC-Dionex4000i/4500	2.792e+03	ug/g
ICP (Acid Digest) All Metals		
Aluminum -ICP-Acid Digest	6.65e+00	ug/g
Antimony -ICP-Acid Digest	<6.52e+00	ug/g
Arsenic -ICP-Acid Digest	<1.09e+01	ug/g
Barium -ICP-Acid Digest	<5.43e+00	ug/g
Beryllium -ICP-Acid Digest	<5.43e-01	ug/g
Bismuth -ICP-Acid Digest	<1.09e+01	ug/g
Boron -ICP-Acid Digest	6.30e+00	ug/g
Cadmium -ICP-Acid Digest	<5.43e-01	ug/g
Calcium -ICP-Acid Digest	4.67e+01	ug/g
Cerium -ICP-Acid Digest	<1.09e+01	ug/g
Chromium -ICP-Acid Digest	2.00e+00	ug/g
Cobalt -ICP-Acid Digest	<2.17e+00	ug/g
Copper -ICP-Acid Digest	3.93e+00	ug/g
Iron -ICP-Acid Digest	1.97e+01	ug/g
Lanthanum -ICP-Acid Digest	<5.43e+00	ug/g
Lead -ICP-Acid Digest	<1.09e+01	ug/g
Lithium -ICP-Acid Digest	<1.09e+00	ug/g
Magnesium -ICP-Acid Digest	<1.09e+01	ug/g
Manganese -ICP-Acid Digest	4.34e+01	ug/g
Molybdenum -ICP-Acid Digest	<5.43e+00	ug/g

Neodymium -ICP-Acid Digest	<1.09e+01	ug/g
Nickel -ICP-Acid Digest	6.51e+00	ug/g
Phosphorus -ICP-Acid Digest	<2.17e+01	ug/g
Potassium -ICP-Acid Digest	<5.43e+01	ug/g
Samarium -ICP-Acid Digest	<1.09e+01	ug/g
Selenium -ICP-Acid Digest	<1.09e+01	ug/g
Silicon -ICP-Acid Digest	7.73e+00	ug/g
Silver -ICP-Acid Digest	<1.09e+00	ug/g
Sodium -ICP-Acid Digest	9.63e+01	ug/g
Strontium -ICP-Acid Digest	<1.09e+00	ug/g
Sulfur -ICP-Acid Digest	2.55e+01	ug/g
Thallium -ICP-Acid Digest	<2.17e+01	ug/g
Titanium-ICP-Acid Digest	<1.09e+00	ug/g
Uranium -ICP-Acid Digest	<5.43e+01	ug/g
Vanadium -ICP-Acid Digest	<5.43e+00	ug/g
Zinc -ICP-Acid Digest	4.48e+00	ug/g
Zirconium -ICP-Acid Digest	<1.09e+00	ug/g
OTHER ANALYSIS		
Ammonia-by ISE-Std Additions	1.01e+05	ug/g
Amount of Sample Present	0.1874	g
DSC Exotherm using Mettler	759.5	Joules/g
Digestion done by PCL	9.2000	g/L
Received Sample Yet?	received	
Tot. Organic Carbon by Coul.	9.09E+04	ug/g

Appendix H
Material Safety Data Sheet for Anchorlube G-771™

ANCHOR CHEMICAL CO

MSDS FOR ANCHORLUBE

IDENTITY - ANCHORLUBE G-771

MANUFACTURER - ANCHOR CHEMICAL CO
777 CANTERBURY RD
WESTLAKE, OH 44145

PHONE - 216/871- 1660
DATE PREPARED - 3/1/96

HAZARDOUS MATERIALS - NONE - TO BE CONSIDERED NON-HAZARDOUS
CONTAINS 4% POWDERED MICA - LISTED AS A NUISANCE ITEM ON SOME RTK LISTINGS - TRAPPED IN SOAP BASE SO IT CANNOT BECOME AIRBORNE AND PRESENT ANY INHALATION POSSIBILITY.

THIS MATERIAL WOULD BE CONSIDERED A NON-CONTROLLED ITEM IN CANADA

HMIS RATING - HEALTH - 1, FLAMMABILITY - 0, REACIVITY - 0, PROTECTION - A

PHYSICAL/CHEMICAL CHARACTERISTICS

BOILING POINT - 225'F	SP. GRAVITY - 1.0365
VAPOR PRESSURE - NOT APPLICABLE	MELT POINT - NOT APPLICABLE
VAPOR DENSITY - NOT APPLICABLE	EVAPORATION RATE - N/A

DISPERSABLE IN WATER - A GREEN SEMI-PASTE MATERIAL WITH LEMONY ODOR

FIRE OR EXPLOSION DATA

FLASH POINT - NONE - MATERIAL CONSISTS OF OVER 50% WATER
EXTINGUISHING MEDIA OR SPECIAL FIRE FIGHTING PROCEDURES - NONE

REACTIVITY DATA

STABLE - INCOMPATABILITY - MATERIALS TO AVOID -NONE KNOWN

HAZARDOUS DECOMPOSITION - NONE KNOWN
HAZARDOUS POLYMERZATION - WILL NOT OCCUR

HEALTH HAZARD

ENTRY ROUTE POSSIBLE - *INHALATION* (YES) - *SKIN* - (NO)- *INGESTION* - (YES)
EXCEPT FROM WELDING PARTS CONTAINING AN ANCHOLUBE COATING, THE *INHALING* WOULD BE A HIGHLY UNUSUAL HAPPENING. - *INGESTION* - ANY SMALL AMOUNT OF MATERIAL WOULD CAUSE VOMITING BECAUSE OF THE SOAP BASE - FOR THIS REASON, KEEP OUT OF EYES AS IT WILL CAUSE SEVERE STINGING

THERE ARE NO CARCINOGENS - NTP - NO - IARC MONOGRAPHS - NIF - OSHA REGULATED - NO

SIGNS OR SYMPTOMS OF EXPOSURE

EYES - SEVERE STINGING AND REDNESS OF CONJUCTIVE TISSUE - IRRIGATE WITH COOL WATER TO REMOVE AND GET MEDICAL ATTENTION IF FELT NECESSARY. SOME MINOR IRRITATION MAY OCCUR AND IS REVERSABLE AFTER A SHORT PERIOD OF TIME. --- SOME *PRIOR SKIN CONDITIONS* MAY BE AGGRAVATED. IF ANIMAL BASE HAND SOAPS IRRITATE, ANCHORLUBE MAY IRRITATE SKIN. WASH WITH DETERGENT OR SOAP AND WATER.

SAFE HANDLING AND USE - WHEN POSSIBLE, RETURN TO CONTAINER OR SOAK UP WITH CLAY AND DISPOSE OF INTO SANITARY LAND-FILL. SMALL AMOUNTS MAY BE MOPPED UP AND WASH WATER MAY BE POURED INTO SANITARY SEWER. DISPOSAL METHOD IS SAME AS ABOVE.

PRECAUTIONS IN STORAGE - MATERIAL FREEZES AND SOME SEPARATION MAY OCCUR. STIR MATERIAL UNTIL SMOOTH. FREEZING WILL NOT EFFECT CAPABILITY OF MATERIAL TO PERFORM.

RESPIRATORY PROTECTION MEASURES - NONE EXCEPTING THE SMOKE FROM WELDING PARTS COATED WITH MATERIAL. IN THAT EVENT, LOCAL EXHAUST TO REMOVE IRRITATING SMOKE WOULD BE REQUIRED.

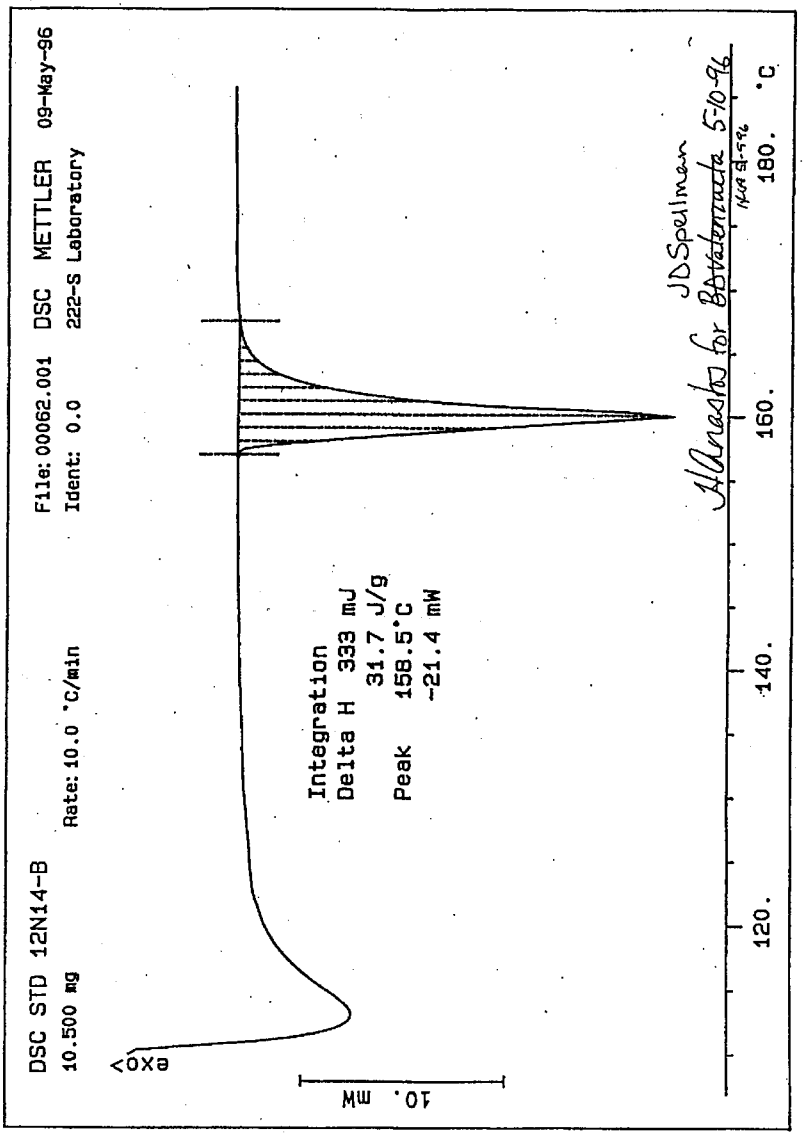
OTHER THAN SAFETY GLASSES, NO OTHER PROTECTIVE EQUIPMENT OR CLOTHING IS REQUIRED.

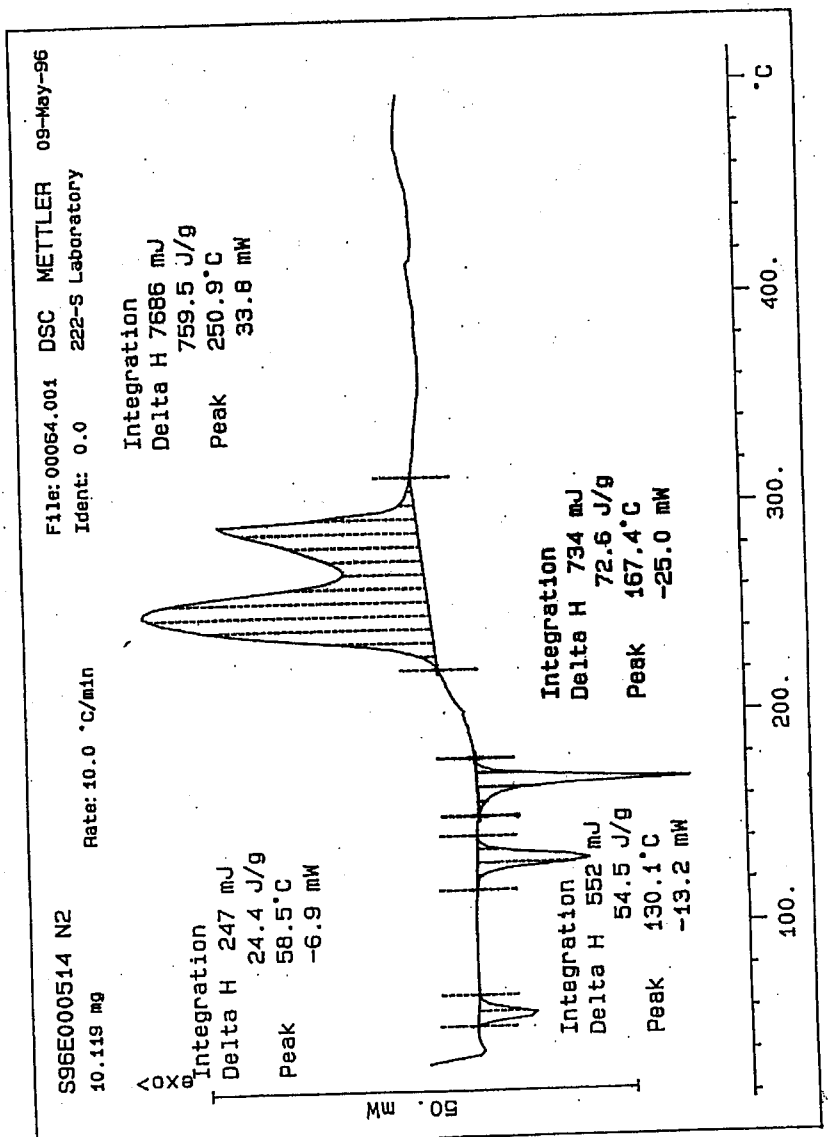
SPECIFICATION & COMPOSITION ANALYSIS

ANCHORLUBE is a Sodium Oleate Emulsion made from processed & unprocessed animal/vegetable oils. It is water extendable up to 1.5:1. ANCHORLUBE has no added sulfur, chlorine/fluorine, chromates, nitrites, phenols, formaldehyde or mercury based compounds. There are also no silicones in this product. The other ingredients are inert filler pigments and an odor mask.

INDREDIENTS	*C.A.S.*	*%*
ANIMAL TALLOWS	61789-97-7	10-15
OLEIC ACIDS	112-80-1	5-10
TRIETHANOLAMINE	102-71-6	3-5
TALL OIL SOAPS	61790-45-2	20
TRI-SODIUM PHOSPHATE	7601-54-9	1
MICA	12001-26-2	4
CALCIUM CARBONATE	471-34-1	3
SMECTITE CLAY	1327-43-1	3-5
GREEN PIGMENT	4430-16-4	TRACE
TEKTAMER (BACTERIOSTAT)	35691-65-7	.01
ODOR MASK	MIXTURE	.01
WATER	7732-18-5	50+

Appendix I
103-AX Green Substance Calorimetry


DSC STD 12N14-B
10.500 mg
Rate: 10.0 °C/min
File: 00062.001
Ident: 0.0
DSC METTLER 09-May-96
222-S Laboratory
Integration
Delta H 333 mJ
31.7 J/g
Peak 158.5°C
-21.4 mW
10. mW
exo>
120.
140.
160.
180.
°C
JDSpellman
for BDTalbernacle 5-10-96


S96E000514 N2
10.119 mg
Rate: 10.0 °C/min
File: 00064.001 DSC METTLER 09-May-96
Ident: 0.0 222-S Laboratory
Integration
Delta H 7686 mJ
759.5 J/g
Peak 250.9°C
33.8 mW
Integration
Delta H 247 mJ
24.4 J/g
Peak 58.5°C
-6.9 mW
Integration
Delta H 734 mJ
72.6 J/g
Peak 167.4°C
-25.0 mW
Integration
Delta H 552 mJ
54.5 J/g
Peak 130.1°C
-13.2 mW
Exo
50. mW
100.
200.
300.
400.
°C