

1349

1349

HAVERHILL SOLAR ENERGY PROJECT

PROJECT STATUS REPORT

January 1, 1980 to May 31, 1980

Introduction

Under Cooperative Agreement DE-FC03-79CS30310, the U.S. Department of Energy, the Columbia Gas System Service Corporation and the USS Chemicals Division of United States Steel Corporation are jointly funding a project to design a 50,400 square foot solar energy system to provide 150 psi industrial process steam for the production of polystyrene at the USS Chemicals Haverhill, Ohio plant.

The design phase of the project (Phase I) was originally scheduled for the eight-month period from September 28, 1979 through May 31, 1980. It is expected that the agreement period will be formally extended until July 31, 1980. This report covers the period January 1, 1980 through May 31, 1980.

Summary of Activities

The Preliminary Design Report and Preliminary Design Drawings for the Haverhill Solar Energy Project were delivered to the U.S. Department of Energy - San Francisco Operations Office and to the Project Advisors in early January, 1980. This Preliminary Design Report and Drawings covered work performed during the first three months of the design phase - September 28, 1979 to December 31, 1979. The Haverhill project team reviewed the solar energy system preliminary design with U.S. DOE - SAN Staff and the Project Advisors at a meeting in Oakland, California on January 23, 1980.

During the period January 24, 1980 through April 13, 1980 numerous steps were taken by the Haverhill project design team to correct deficiencies in the preliminary design and to complete aspects of the design that had not been addressed during the first three months of the design phase. Revised Haverhill solar energy system construction drawings, the Design Analysis for the Haverhill Solar Project and the Haverhill Solar Energy Project Specifications were released on April 14, 1980 and sent to U.S. DOE - SAN and the Project Advisors.

The Haverhill project design team has maintained the practice of meeting monthly to exchange information on project progress and to review past and future work schedules. Because of the number of topics discussed and the level of detail, this information from these meetings has been relegated to the Appendices.

During the period April 15 through May 15, 1980, work on four more separate project documents was completed. These separate project reports were entitled "Environmental Assessment", "Safety Analysis", "Site Data Acquisition System" and "Economic Analysis". These reports were released on May 16, 1980.

The Haverhill project team reviewed the changes and additions to the Haverhill solar energy system construction drawings, the project specifications, the design analysis, and the "Economic Analysis" and "Site Data Acquisition System" reports mentioned above with the U.S. DOE - SAN Staff and the Project Advisors at the Eighty Percent Design Review meeting in Oakland on May 21, 1980.

Columbia Gas submitted a Preliminary Cost Proposal for Phase II of the project (solar energy system fabrication and installation) to U.S. DOE - SAN on May 28, 1980.

Future Work

Several changes in the Haverhill Solar Energy System design were recommended at the Eighty Percent Design Review meeting on May 21, 1980. The Haverhill project design team has reviewed some of these recommendations since the meeting and has decided to revise the construction drawings and project specifications to reflect the following recommended changes:

1. Wherever possible the solar collector loop piping will be changed to welded connections instead of screwed connections.
2. Check valves at the exit of each solar collector row will be replaced with block valves. Pressure relief valves will be added at the inlet to each collector row. The pressure relief from the solar collector absorber will be connected back to the solar collector loop main to eliminate the need for separate, distributed pressure relief receiver tanks or pressure relief return plumbing in the solar collector field.
3. The solar collector loop plumbing that is below grade will be changed to above grade.
4. All valve stems/orientations will be changed to horizontal.
5. Pipe supports not shown on construction drawing S-1 will be picked up.
6. Valves that are not shown on construction drawing M-3 will be picked up.

The Haverhill project team is still reviewing several other DOE-SAN Staff/Project Advisors recommendations. Recommendations that probably will not be implemented are:

1. Fiberglass insulation was called out for all solar collector loop piping in the Haverhill preliminary design drawings. All of the Haverhill solar energy system construction drawings have been changed to Foamglas. The incremented cost to change to Foamglas including material and labor is large - estimated to be \$16,500 or 0.8% of the total project cost. Additionally, the thermal conductivity of Foamglas is greater than (dry) fiberglass. However, even with extremely good installation techniques, fiberglass insulation can be expected to absorb moisture during rainstorms. This moisture will be vaporized during solar system start-up, adding to solar system warm-up losses. Foamglas also has the advantage of greater crush resistance, which should give better long term durability and performance for a field installation. Foamglas is available in preformed shapes to encase valves, air bleeds, and other components in the piping system which must be insulated for good solar system efficiency. Any attempt to apply Dickinson and Brown economic analysis methodology to evaluate Foamglas versus fiberglass and to tradeoff energy delivered and cost requires numerous assumptions about fiberglass wicking, percent trapped moisture, cover installation procedures, etc. Therefore, Dickinson and Brown methodology has not been employed in this analysis. The Haverhill project team has decided that the greater long term durability and the reduced warm-up losses justify the extra insulation cost.

2. We do not expect to provide emergency power to the heat tape on the solar loop pump cooling water lines. The valves controlling cooling water flow are designed to "fail open" (in the case of loss of electrical power) and water flow will thus be maintained when electrical power is off. Additionally, the pump water jacket is always connected to drain. The pump and the water line outside the steam generator building are designed to self drain in the case water flow is stopped or interrupted.

The Haverhill project team is still reviewing some aspects of the solar system design.

1. We are evaluating the solar collector pylon/anchor design to determine the advantages and disadvantages of changing to two types of pylons ("drive pylons" and "non-drive pylons").
2. We are reviewing the construction drawings to determine if nitrogen bleeds are included at all high points in the plumbing system.
3. The site data acquisition system will be changed if U.S. DOE desires total and diffuse solar radiation measured in the plane of the tracking solar collector. We prefer to measure total and diffuse solar radiation on a tilted plane with either a fixed slope angle or a monthly adjusted slope angle.

The project team will respond to DOE - SAN Staff or Project Advisor requests for additional analysis or revision of the "Environmental Assessment", "Safety Analysis", "Site Data Acquisition System" and "Economic Analysis" reports released on May 16, 1980.

APPENDIX A

Minutes of Haverhill
Solar Energy Project
Meetings

Recorded by: Columbia

HVERHILL SOLAR INDUSTRIAL PROCESS STEAM PROJECT

First Monthly Meeting Minutes

October 11, 1979

USS Chemicals Haverhill Plant

List of Attendees

| <u>Name</u> | <u>Company</u> | <u>Location</u> | <u>Phone</u> |
|----------------|-----------------------------|-----------------|--------------|
| Arnold Cohen | General Electric | Valley Forge | 215-962-1216 |
| Phil Dechow | Columbia Gas | Columbus | 614-486-3681 |
| Stan Demski | USS Chemicals | Haverhill | 614-532-3420 |
| Mike Fedorenko | USS Chemicals Central Engr. | Pittsburgh | 412-433-6344 |
| Dave Leon | Columbia Gas | Columbus | 614-486-3681 |
| Jim Lockard | H. A. Williams & Assoc. | Columbus | 614-451-1711 |
| Lowell Mast | H. A. Williams & Assoc. | Columbus | 614-451-1711 |
| Ed Reid | Columbia Gas | Columbus | 614-486-3681 |
| Rick Warner | USS Chemicals | Haverhill | 614-532-3420 |
| Edward Young | U.S.S. Research Department | Pittsburgh | 412-372-1212 |

The first monthly Haverhill Solar Project Meeting was held October 11, 1979 at 9:00 a.m. at the USS Chemicals Haverhill Plant.

Phil Dechow presented a review of the Department of Energy Solar Industrial Process Heat projects. There have been four separate DOE solicitations for Solar Industrial Process Heat projects. The first three solicitations were Request for Proposals (RFP's) for 10,000 square foot solar systems. The first solicitation (Cycle 1) was for solar industrial heat applications for temperatures up to 212°F. Cycle 2 applications were in the temperature range 212°F to 350°F and Cycle 3 applications were in the temperature range of 350°F to 550°F. For Cycle 1, three different contractors were awarded contracts for the design phase and all three contractors were funded for solar system construction. For Cycle 2, four different contractors were selected for the design phase and three of these contractors were funded for solar system construction. For Cycle 3, eight different contractors were

selected for the design phase and four of these contractors were funded for solar system construction. The fourth solicitation was a Program Opportunity Notice (PON) for 50,000 square foot solar systems for applications in the temperature range of 212°F to 550°F. For Cycle 4, four contractors were selected for the design phase and DOE has announced that only one of these large 50,000 square foot systems will be installed. The design phase of the Haverhill Solar Energy Project was funded under the Cycle 4 PON. DOE expects to release early in 1980 the criteria for selecting the one 50,000 square foot system that will be constructed with DOE cost sharing.

Phil Dechow reported that contract negotiations with the Department of Energy San Francisco Office have been completed. During negotiations a few changes were made in the schedule and there was further definition of the Phase II cost estimates that must be provided during Phase I.

It was announced that Columbia expects to select H. A. Williams and Assoc. as the consulting engineers for this project. H. A. Williams and Assoc. were the consulting engineers on the Highlights Solar Energy Project, a commercial office building solar energy retrofit in Columbus.

Arnold Cohen of General Electric Company presented information on the G.E. TC-300 solar collector. Collector testing performed by Desert Sunshine Exposure Testing, Inc. (DSET), a DOE approved independent solar test facility, revealed that the particular TC-300 solar collector module tested at DSET did not have as good efficiency as earlier TC-300 solar collector modules tested at Valley Forge. Recent TC-300 solar collector tests at Valley Forge confirm the DSET test data. General Electric now expects the TC-300 to have a solar collector efficiency of about 30% instead of 40% in the temperature range of 400°F to 425°F.

Based on the new TC-300 collector tests, General Electric is recommending that the TC-300 not be selected for the Haverhill 150 psig steam application. Arnold Cohen suggested that USS Chemicals identify some lower pressure steam applications that are more amenable to the TC-300 solar collector. USS Chemicals will measure the steam usage of various other low pressure steam loads at locations in close proximity to the solar collector array.

Phil Dechow will visit with engineers at Sandia Laboratories on November 15, 1979 to review concentrating solar collector state-of-the-art and to review test results of currently available production solar collectors.

The second monthly Haverhill solar project meeting will be held on November 16, 1979 at 10:00 a.m. at the USS Chemicals Haverhill Plant.

HAVERHILL SOLAR INDUSTRIAL PROCESS STEAM PROJECT

Second Monthly Meeting Minutes

November 16, 1979

USS Chemicals Haverhill Plant

List of Attendees

| <u>Name</u> | <u>Company</u> | <u>Phone</u> |
|------------------|---------------------------|--------------|
| Phil Dechow | Columbia Gas | 614-486-3681 |
| Arun Patel | USS Chemicals | 614-532-3420 |
| Dave Leon | Columbia Gas (Columbus) | 614-486-3681 |
| Scott Phelps | Columbia Gas (Portsmouth) | 614-354-2836 |
| Lowell Mast | H. A. Williams & Assoc. | 614-451-1711 |
| Robert Mershimer | USS Chemicals | 614-532-3420 |
| Paul Wolownik | U. S. Steel Corp. | 614-539-9076 |
| Rick Warner | USS Chemicals | 614-532-3420 |

The second monthly Haverhill Solar Project Meeting was held November 16, at 10:00 a.m. at the USS Chemicals Haverhill Plant.

Rick Warner has contacted two land surveying firms and asked them to submit cost quotations to perform the necessary topographic survey of the solar collector field area. Elswick of Wheelersburg submitted a cost quotation of \$1900 and F. R. Gesling, Land Surveyors, of Ashland, Kentucky submitted a bid of \$1300. F. R. Gelsing was selected to perform the survey. Rick Warner will also contact firms about obtaining core samples from the solar collector field area.

A discussion of the polystyrene plant steam consumption was presented by Arun Patel. Steam consumption pressures of 20 psig, 50 psig and 150 psig were considered for the solar process steam project. After evaluation of the piping run lengths, potential warm-up thermal losses, operating

thermal losses of the system, quantity of steam required and profile of steam usage the decision was reached to continue with the previously selected 150 psig steam application in the reactor area of the polystyrene plant. This particular steam load offers the advantage of high continuous steam usage 24 hours per day, 365 days per year. Additionally, this application has the shortest possible solar system piping runs which will minimize both installation cost and standby and operational heat losses.

We previously had selected a site for the unfired steam generator inside the 200 area of the polystyrene plant. Because of expansion plans for the polystyrene plant an alternative site for the unfired steam generator outside the present building was proposed. A small new building would be built to house the steam generator, pumps and other mechanical and electronic equipment. This new location has the disadvantage of longer piping runs. Additionally, the future "viewability" of the solar system hardware will be reduced if the new building is built just large enough to house the mechanical equipment.

Rick Warner reported that the blueprints of the structural drawings and steam distribution drawings for the reactor area and centrifuge area will have to be ordered from Pittsburgh. Copies of these prints will be sent to H. A. Williams and Columbia as soon as they are received by USS Chemicals.

Phil Dechow visited with Sig Thunborg and Jim Banas at Sandia Laboratories to discuss concentrating solar collector state-of-the-art. Phil will visit with three concentrator collector manufacturers (Acurex, Solar Kinetics and Suntec) within the next two weeks to review the collector hardware and select the solar collector to be used on the project.

It was noted by Arun Patel that there is an existing condensate line from the atmospheric condensate receiver to the general location of the

unfired steam generator for the solar system.

Phil Dechow reported that Columbia is fabricating a test rack that will be used to hold reflector and receiver materials for on-site environmental exposure tests. This rack will be placed on the proposed solar array site in January, 1980. USS Chemicals has agreed to take a few samples off the test rack each month and mail them to Sandia Laboratories.

The third monthly project meeting will be held December 13, 1979 at 2:00 p.m. at the USS Chemicals Haverhill Plant.

HAVERHILL INDUSTRIAL SOLAR ENERGY PROJECT

Third Monthly Meeting Minutes

December 13, 1979

USS Chemicals Haverhill Plant

List of Attendees

| <u>Name</u> | <u>Company</u> | <u>Phone</u> |
|-------------|----------------|--------------|
| Phil Dechow | Columbia Gas | 614-586-3681 |
| Stan Demski | USS Chemicals | 614-532-3420 |
| Dave Leon | Columbia Gas | 614-486-3681 |
| Jim Lockard | H. A. Williams | 614-451-1711 |
| Lowell Mast | H. A. Williams | 614-451-1711 |
| James McKee | USS Chemicals | 614-532-3420 |
| Al Walker | USS Chemicals | 614-532-3420 |
| Rick Warner | USS Chemicals | 614-532-3420 |

The third monthly Haverhill Solar Energy Project Meeting was held December 13, 1979 at 10:00 a.m. at the USS Chemicals Haverhill Plant.

F. R. Gesling, Land Surveyors, of Ashland, Kentucky, completed the topographic survey of the solar collector array site and submitted their map and report on December 5, 1979. Rick Warner will contact firms about taking core samples from the solar collector field area.

Phil Dechow presented an evaluation of three line-focusing, tracking, parabolic concentrating collectors and a line-focusing, non-tracking compound parabolic concentrating collector that were considered for the Haverhill Solar Energy project. The four collectors were: Acurex 3001, General Electric TC-300, Solar Kinetics T-700, and Suntec SH-1655. The project team

selected the Solar Kinetics T-700 parabolic trough solar collector on the basis of collector cost, estimated installation cost, estimated maintenance cost, collector performance and durability.

Dave Leon reported on the selection of the heat transfer fluid for the solar collector loop. The heat transfer fluid selection is very important because it impacts on other solar system components, such as pumps and heat exchangers. Gulf Synfluid 4cs has been tentatively selected as the heat transfer fluid for the Haverhill Solar System. This fluid offers the best combination of heat transfer and viscosity properties with low flammability and low toxicity.

Jim Lockard reviewed several alternative solar collector field layouts. Layouts of three banks of collectors with each bank containing 20 rows of collectors and layouts of four banks of collectors with each bank containing 15 rows of collectors were presented. These different layouts were shown aligned with both true N-S and true E-W. The Haverhill plant is laid out with a rectangular grid system of roads. Plant North is 65 degrees East of true North for this rectangular grid. A rectangular solar collector array laid out true N-S or true E-W does not utilize the land area particularly well. H. A. Williams and Columbia will consider other solar collector array layouts that conform to plant N-S and plant E-W.

Rick Warner will provide plans of water and sewer lines in the work area to H. A. Williams.

Preliminary steps will be taken to evaluate the most cost effective means of cleaning the solar collectors. USS Chemicals will investigate cost and availability of mobile wash equipment that can be contracted or leased locally.

Drums or tank trucks will be used as receptacles for the heat transfer fluid in the event the solar collector loop must be drained for servicing. No large drain tank will be included in the solar system.

All makeup water for the plant steam system is deaerated and treated. Makeup water is added at the main steam plant. Since the condensate provided to the unfired steam generator in the solar system will receive pure condensate, only occasional manual blow down will be required to remove sediment. Blow down heat recovery equipment will not be economically practical.

At the November Project Team meeting, the decision was made to site the steam generator at the southeast corner of the 200 area outside the polystyrene plant. Lowell Mast presented an analysis of the cost and technical impact of this decision. After further discussion by the project team, Al Walker suggested moving the steam generator to a location adjacent to the solar collector field. This location will significantly reduce the length of the solar collector loop heat transfer fluid mains. In addition, the solar system connection to the plant 150 psig steam system can be made at a much closer location - at the northwest corner of the maintenance building. The 2 inch steam generator feed line will be longer for this location. H. A. Williams will re-layout the solar system components with the unfired steam generator at this new location.

The next monthly project meeting will be held January 18, 1980 at 9:00 a.m. at the USS Chemicals Haverhill Plant.



J. Philip Dechow

HVERHILL INDUSTRIAL SOLAR ENERGY PROJECT

Fourth Monthly Project Meeting

January 18, 1980

at

USS Chemicals Haverhill Plant

List of Attendees

| <u>Name</u> | <u>Company</u> | <u>Phone</u> |
|---------------|----------------|--------------|
| Phil Dechow | Columbia Gas | 614-486-3681 |
| Stan Demski | USS Chemicals | 614-532-3420 |
| Dave Leon | Columbia Gas | 614-486-3681 |
| Jim Lockard | H.A. Williams | 614-451-1711 |
| Lowell Mast | H.A. Williams | 614-451-1711 |
| Bob Mershimer | USS Chemicals | 614-542-3420 |
| Jim McKee | USS Chemicals | 614-532-3420 |
| Arun Patel | USS Chemicals | 614-532-3420 |
| Al Walker | USS Chemicals | 614-532-3420 |

Meeting Notes

1. Steam generator floor drain will run to ditch. Ditch already has oil skimmer.
2. Data Acquisition System will include a temperature sensor at the outlet of each solar collector row.
3. Solar collector field drainage tile will require an oil skimmer at the ditch.
4. One maintenance access aisle will be considered between adjacent solar collector rows. This would require the interconnecting piping from the end of one 120 foot long collector row to the end of the adjacent collector row to be underground.
5. HAW will review with Patterson-Kelley that this solar system application requires a steam generator that can withstand numerous warmup and cooldown cycles. Generator tubes must not have fatigue problems or sealing problems with many thermal cycles.
6. HAW will determine type of pumps and pump seals that can operate at this temperature. Pump cooling may be required.

7. USS Chemicals will require a steam separator at the outlet from steam generator. Steam separator must be designed to trap out any entrained oil.
8. USS Chemicals will contact surveyor to have site survey extended to include all of solar collectors field area.
9. Columbia will be responsible for directing the construction contractor in temperature balancing the solar collector field.
10. Columbia will also use ultrasonic non-intrusion flow meter to check the flow rate in each solar collector row after field is temperature balanced.
11. Columbia wants separate data acquisition room in the steam generator building. Need vapor barrier to prevent any steam from entering data acquisition room.
12. USS Chemicals wants solar collector loop pumps moved outside steam generator building. Plant surveillance and maintenance procedures are simplified when pumps are outside. USS Chemicals routinely installs their pumps outside throughout the complex .
13. Decision was reached to contract solar collector cleaning to local spray wash firm. De-ionized water is available adjacent to solar collector field and will be used to fill contractor's cleaning equipment tank truck.
14. Solar collector field must be fenced for plant security.
15. HAW will contact Standard Slag Co. at New Boston for information on availability of slag. Probably use base course of about 4-inch slag and a finer chat for top course to provide good footing.
16. Project team reviewed plant E-W and plant N-S field orientations. HAW to continue evaluations to optimize field solar collector loop piping. Columbia to determine annual solar collection with two different field orientations.
17. HAW will evaluate methods to eliminate cost of running new electrical service to the solar system. We will consider running power from maintenance building if adequate capacity exists.
18. All pump controllers will have "Off - Auto - On" hand switch controls.

HAVERHILL INDUSTRIAL SOLAR ENERGY PROJECT

Fifth Monthly Project Meeting

February 21, 1980

at

USS Chemicals Haverhill Plant

List of Attendees

| <u>Name</u> | <u>Company</u> | <u>Phone</u> |
|---------------|----------------|--------------|
| Phil Dechow | Columbia Gas | 614-486-3681 |
| Stan Demski | USS Chemicals | 614-532-3420 |
| Dave Leon | Columbia Gas | 614-486-3681 |
| Jim Lockard | H.A. Williams | 614-451-1711 |
| James McKee | USS Chemicals | 614-532-3420 |
| Bob Mershimer | USS Chemicals | 614-532-3420 |
| Arun Patel | USS Chemicals | 614-532-3420 |
| Scott Phelps | Columbia Gas | 614-354-2836 |
| Al Walker | USS Chemicals | 614-532-3420 |
| Rick Warner | USS Chemicals | 614-532-3420 |

Meeting Notes

Jim Lockard of H.A. Williams recorded meeting minutes. See H.A. Williams meeting minutes.

HAVERHILL INDUSTRIAL SOLAR ENERGY PROJECT

Sixth Monthly Project Meeting

March 20, 1980

at

USS Chemicals Haverhill Plant

List of Attendees

| <u>Name</u> | <u>Company</u> | <u>Phone</u> |
|---------------|----------------|--------------|
| Phil Dechow | Columbia Gas | 614-486-3681 |
| Stan Demski | USS Chemicals | 614-532-3420 |
| Tom Huff | H. A. Williams | 614-451-1711 |
| Dave Leon | Columbia Gas | 614-486-3681 |
| Jim Lockard | H. A. Williams | 614-451-1711 |
| Jim McKee | USS Chemicals | 614-532-3420 |
| Bob Mershimer | USS Chemicals | 614-532-3420 |
| Al Walker | USS Chemicals | 614-532-3420 |
| Rick Warner | USS Chemicals | 614-532-3420 |

Meeting Notes

1. USS Chemicals is very concerned about safety, parking of contractors, access to construction site, laydown area and security during construction phase of project. Jim Lockard will cover these items in as much detail as possible in the specifications for the project.
2. The construction contractor must provide his own security protection. USS Chemicals strongly advises the construction contractor to hire security personnel. USS Chemicals is willing to hire extra security for the project if they are reimbursed.
3. The construction contractor will be required to supply his own portable toilet, to supply his own electric service and to run his own water from USS Chemicals water to the construction trailer.
4. Contractors will not be allowed to pump into any drainage ditch.
5. We will further clarify and emphasize items #1, 2, 3 and 4 in a pre-bid conference with potential contractors.

6. All EPA Permits (for vented tank) and Building Permits for the project will be obtained and paid for by the contractor and furnished to USS Chemicals.
7. Contractor must provide four copies of operation and maintenance manual to USS Chemicals and one copy to Columbia Gas.
8. Lowell Mast will prepare and submit a proposal to Phil Dechow for H. A. Williams contract supervision of construction phase of the project. USS Chemicals would like to be involved in the construction phase only to the extent necessary for familiarization with solar system operation, control, safety and maintenance. HAW will detail personnel, procedures and responsibilities for construction phase.
9. H. A. Williams will obtain USS Chemicals designation letters and numbers for pumps, steam generator, etc. for the P. & I.D. The valves and pump controls should be detailed on the P. & I.D. All sensor locations for site data acquisition system should be identified with the "line in a bubble" standard designation discussed at the meeting. All sensor locations for alarms should be identified with a "two lines in a bubble" designation. The alarm locations should also be identified. H. A. Williams will revise the P. & I.D. and send to USS Chemicals for review as soon as possible.
10. USS Chemicals will review codes and their standard practices to determine if solar collector motor underground power wiring must be encased in red concrete.
11. H. A. Williams will review plumbing of steam separator shown on sheet M-3. Columbia Gas recommended that steam separator trap should discharge into blowdown separator instead of as currently shown. Steam separators should be downstream of check valve.
12. H. A. Williams will review the cycling of steam generator feed pumps. USS Chemicals feels steam generator feed pumps should run continuously with a modulating control valve to maintain water level in steam generator. Columbia Gas suggested steam generator feed pumps be allowed to run only when solar collector loop pumps are running.
13. USS Chemicals suggested moving the blowdown separator outside the building.
14. Columbia Gas provided twelve mailing containers to USS Chemicals for mailing the environmental exposure test samples to McDonnell Douglas Astronautics Company.

The next project review meeting will be held at USS Chemicals on April 24, 1980 at 10:00 a.m.

HAVERHILL INDUSTRIAL SOLAR ENERGY PROJECT

Seventh Monthly Project Meeting

April 24, 1980

at

USS Chemicals Haverhill Plant

List of Attendees

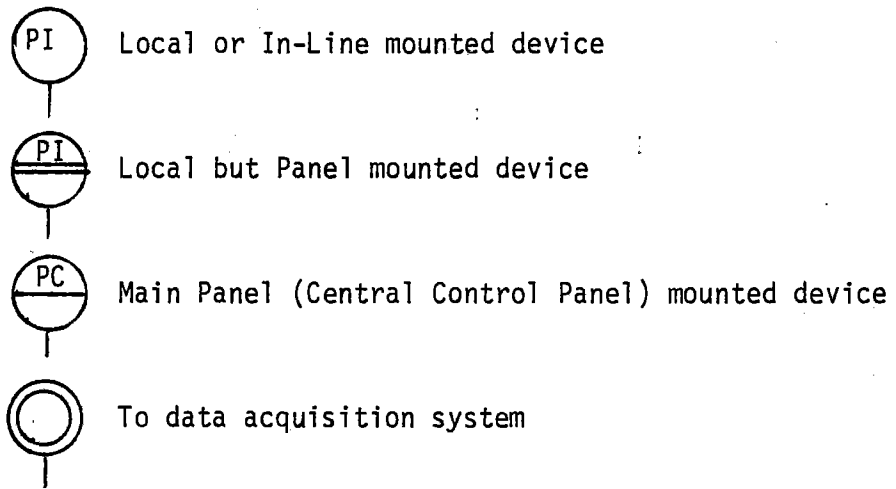
| <u>Name</u> | <u>Company</u> |
|---------------|----------------|
| Phil Dechow | Columbia Gas |
| Stan Demski | USS Chemicals |
| Jim McKee | USS Chemicals |
| Lowell Mast | H. A. Williams |
| Bob Mershimer | USS Chemicals |
| Arun Patel | USS Chemicals |
| Ed Reid | Columbia Gas |
| Al Walker | USS Chemicals |
| Rick Warner | USS Chemicals |

Meeting Notes

1. Lowell Mast will have the P & ID revised to reflect changes recommended by USS Chemicals. PSV should be shown on P & ID.
2. There will be a floor drain in the southwest corner of the building.
3. H.A.W. will add a shower in the southwest corner of the building.
4. Rick Warner will review the fire extinguishers shown on drawings and inform H.A.W. if there is any needed modification.
5. Lowell Mast will make sure the nitrogen separator has been included in the specifications.
6. H.A.W. will forward nitrogen separator model number and manufacturer's name to Phil Dechow.
7. H.A.W. will review the size of the steam generator building to insure that there is room for visitors to stand in both the steam generator and the data acquisition room.

8. Lowell Mast will compile a listing of all applicable codes and standards prior to the May 21, 1980 Design Review in Oakland.
9. The construction drawings do not show the power wiring to the solar collector drive motors encased in red concrete. Rick Warner will review this and inform H.A.W. if this complies with USS Chemicals construction practices.
10. H.A.W. will add glass windows in the wall between the data acquisition room and the steam generator room in the steam generator building.
11. H.A.W. will forward a copy of the report from the S.K.I. consultant on the solar collector support post foundation.
12. H.A.W. will include either manual valves or automatic regulator for adding nitrogen cover gas to the oil expansion tank.
13. H.A.W. will consider loss of electrical power and determine the system valve positions that will occur when there is a loss of power.
14. H.A.W. will check the Patterson-Kelley specifications to make sure the level controller is a modulating type. On-off controller is not desirable for this system.
15. H.A. Williams will show the steam generator level controls and safeties on the P and ID.
16. H.A. Williams will show the steam generator blow down valves and lines on the P and ID.
17. H.A. Williams will show the condensate receiver with low level sensor and controller of pumps P-817A and P-817B on the P & ID.
18. H.A.W. will check with Patterson-Kelley to determine if site glasses have valves for blowdown.
19. H.A.W. will show 4" steam separator lines and valves on all applicable drawings.
20. USS Chemicals will provide positive displacement pump symbol.
21. H.A.W. will add nitrogen separator section in the specifications.
22. H.A.W. will show a single alarm from the solar collector field to the polystyrene wet side control room.

23. Design team agreed on the following symbols for P & ID.



HAVERHILL SOLAR ENERGY PROJECT
EIGHTY PERCENT DESIGN REVIEW
DOE-SAN FRANCISCO OFFICE
OAKLAND, CALIFORNIA
May 21, 1980

Meeting Notes

1. H.A.W. will evaluate feasibility and necessity of supplying emergency power to electric tracing of solar loop pump cooling water in the event there is a power failure.
2. DOE recommends that solar collector field be manually washed (instead of designing and installing an automatic wash system).
3. USS Chemicals will implement any necessary procedure to stow collectors during days of field plowing and fertilizing in fields adjacent to collector array site.
4. It was recommended that the solar collector washing schedule include a collector washing after both the spring plowing and the fall harvesting of crops in fields adjacent to the solar collector site.
5. H.A.W. will evaluate Duane Randall's conclusion that the solar collector foundation design is too conservative. H.A.W. will determine the advantages and disadvantages of a reducing non-drive pylon foundation size.
6. H.A.W. will pick up all the pipe supports that are not shown on sheet S-1.
7. H.A.W. will review the advantages and disadvantages of a welded vs. flanged or screwed piping design -- including an analysis of valve selection for both systems and an analysis of costs.
8. Project advisors recommend that all valve stems be located horizontal or down. USS prefers horizontal. H.A.W. will incorporate this recommendation in our design.
9. H.A.W. will determine the cost difference for a block valve plus rupture disk or pressure relief valve instead of the check valves we presently are specifying for outlet of each collector row.
10. H.A.W. will determine material and labor cost impact if we specify fiber glass instead of foam glass. Foam glass must be retained in load bearing areas of the insulation (can we use fiber glass at 510°F?). Phil Dechow will review this analysis and report to Bill Nettleton.
11. Phil Dechow will send fluid velocity calculation to Ed McBride.
12. Ken Bergeron suggested that the Dickinson and Brown economic analysis methodology be used to evaluate system changes that tradeoff energy delivered and cost. The figure of merit should be annualized energy cost.

13. Bill Marlatt cautioned the Haverhill design team that trapped air, nitrogen and water vapor can pose problems in fluid distribution systems. H.A.W. will evaluate Haverhill design to determine if air bleeds are included at all necessary points in the system. H.A.W. will create a list of the air bleeds, including locations by sheet number.
14. The DOE reviewers have strong bias to keeping solar collector plumbing above grade. Columbia would like to see present Haverhill design changed to all above ground plumbing. H.A.W. will resolve this issue with USS Chemicals as soon as possible.
15. Haverhill Solar Energy Systems Specifications should reflect that Columbia Gas will flow and temperature balance the solar collector field. The operating procedure for checking the flow and temperature balance, and for re-balancing the field if ever necessary, will be included in the Haverhill Solar Energy Systems Operation and Maintenance Manual.
16. H.A.W. will pick up the valves that are missing on sheet M-3 (refer to sheet M-7).
17. Phil Dechow will send copy of Haverhill solar energy systems news release to all reviewers.
18. Phil Dechow will forward rationale for selecting transmitters for RTD's to Chuck Kutscher.
19. H.A.W. will evaluate potential cost saving that would result from changing to 480 volt solar collector hydraulic power unit motors in the field.
20. Phil Dechow will check on possibility of using venturi or vortex shedding flow meters instead of (or in conjunction with) target type flow meters.
21. Phil Dechow will call Chuck Kutscher on/or about May 28 to determine if total radiation and diffuse radiation is to be measured in the plane of the collector.
22. Phil Dechow will respond to Ken Bergeron's request for information on our estimates of O, M, PT and I costs.
23. Phil Dechow will review the NBS requirements for heat transfer fluids in SHAC systems.
24. Phil Dechow will forward three copies of all Haverhill Phase I Design Reports to Stan Demski.
25. Phil Dechow will send a copy of the report on the Williard site fire to Lowell Mast.
26. Phil Dechow will prepare Optional Form 60. Targeted mail date for signed Optional Form 60 is on/or before May 29.
27. Phil Dechow will provide blank Optional Forms to H.A.W. for inclusion in Specifications.

28. Mail date for draft of final report, specifications and drawings is June 11, 1980.
29. DOE reviewers to submit comments on draft final report to Columbia by July 16.
30. USS Chemicals will provide Columbia with a list of qualified bidders for the construction phase of the project.
31. Bid documents and drawings will be released to selected bidders on June 12.
32. Due date for bids will be July 12. Bids must be good for 90 days.
33. Columbia will obtain signed Optional Form 60 from Solar Kinetics on July 12. Bid to be good for 90 days.
34. Columbia will submit revised signed Optional Form 60 to U.S. DOE on July 15.
35. Columbia to submit revised final report to DOE and reviewers on July 30.

HAVERHILL INDUSTRIAL SOLAR ENERGY PROJECT

Eighth Monthly Project Meeting

May 29, 1980

at

USS Chemicals Haverhill Plant

List of Attendees

| <u>Name</u> | <u>Company</u> | <u>Phone</u> |
|---------------|----------------|--------------|
| Phil Dechow | Columbia Gas | 614-486-3681 |
| Stan Demski | USS Chemicals | 614-532-3420 |
| Jim Lockard | H.A. Williams | 614-451-1711 |
| Lowell Mast | H.A. Williams | 614-451-1711 |
| Bob Mershimer | USS Chemicals | 614-532-3420 |
| Al Walker | USS Chemicals | 614-532-3420 |
| Rick Warner | USS Chemicals | 614-532-3420 |

Meeting Notes

1. HAW will change all solar collector loop plumbing to above grade.
2. HAW will include automatic nitrogen make-up system for solar collector loop expansion tank.
3. HAW will change solar collector loop plumbing from screwed to welded wherever possible.
4. HAW will check drawings to see that all valve stems are horizontal not vertically up.
5. HAW will change from check valves to block valves at exit of each solar collector row.
6. HAW will add pressure relief valve for each solar collector absorber. Pressure relief of fluid would be back to solar collector loop main.
7. USS Chemicals has been discussing the washing of the collectors with:
Mr. Tom Wright, President
Mobile Pressure Cleaning, Inc.
806 Hoodscreek Drive
Ashland, Kentucky 41101
(606) 329-1306

This company has 2000 gallon mobile tank trucks with 1200 psi on-board pumps. The pumps have a flow rate of 30 gpm and the trucks carry 200 feet of hose. MPC can adjust the nozzle spray pattern and pressure to adapt to a variety of cleaning applications.

8. HAW will use information supplied by USS Chemicals to compile a list of potential bidders for the Haverhill solar energy system construction contract.
9. Steam Generator building will be lengthened 5'4".
10. Foamglas will be used on solar collector loop plumbing.
11. Data Acquisition room heating and cooling will be provided by an electric heat pump.
12. USS Chemicals identified location for contractor to install temporary road and parking for construction vehicles at work site.
13. All flow meters will have a spool piece required to put in the line when flow meter is taken out for repair or calibration.
14. HAW will again check drawings to insure that flowmeters have at least eight pipe diameters upstream and three pipe diameters downstream to any elbow, valve, etc.
15. HAW to review in the specs the major steps contractors must take in precommissioning of the system - flushing, pressure testing, filling, start-up, etc.
16. HAW will study cost impact of changing to 480 volt motors for the solar collectors.
17. HAW will use example provided by USS Chemicals to construct a "Major Responsibility Chart". This chart would identify the separate responsibilities of Columbia, USS Chemicals, and the contractor during Phase II.
18. Contractors will not be required to post a performance bond.
19. Contractors will be required to produce evidence of the kind, type and amount of insurance called for in the project specifications.
20. HAW will draw up a bar schedule for Phase II showing construction milestones. Construction period will be October 1, 1980 through April 30, 1981.
21. Rick Warner will provide HAW with a sample Pre-Bid conference Agenda and Notes.
22. USS Chemicals provided HAW with preferred method for putting corrosion detection patch in steam generator loop.
23. HAW will show new alarm wiring over to polystyrene wet side control room.

APPENDIX B

**Minutes of Haverhill
Solar Energy Project
Meetings**

Recorded by: H. A. Williams



H. A. Williams and Associates, Inc.

CONSULTING ENGINEERS

December 12, 1979

MEETING MINUTES

Re : U.S.S. Chemicals Solar System
Date : November 16, 1979
Place : U.S.S. Chemicals, Haverhill, Ohio

Attendance: Rick Warner, U.S.S. Chemicals
Arun Patel, U.S.S. Chemicals
Stan Demski, U.S.S. Chemicals
Philip Dechow, Columbia Gas Service Corp.
Dave Leon, Columbia Gas Service Corp.
Lowell Mast, H. A. Williams & Assoc., Inc.

1. Polystyrene Steam Study was distributed and discussed by U.S.S. Chemicals.
2. Need for 50# steam in polystyrene is limited and supplied from the 150# condensate. Phenol has use of 150# steam but distance of run makes this impractical.
3. Decision made to produce 150# steam and not utilize the G.E. collectors.
4. U.S.S. Chemicals had quotations from Elswick Inc. and F. R. Gesling Co. for making site topo. Will authorize Monday for completion no later than December 15. H. A. Williams requested at least four soil borings to a depth of 5'. U.S.S. Chemicals reports that the plant area has generally been 2800# to 3200# soil below the frost line.
5. Locations for equipment were discussed and sources of condensate and 150# steam header.

U.S.S. Chemicals suggested the generator go outside of Building 200 Area at N.E. corner in vicinity of former 600# steam boiler and the utilization of a pair of 5 to 8 GPM Aurora Condensate Pumps and 1½" condensate line to this point originating from Area 800 utility building and its associated 20 - 30# flash tank.

Condition of lines and pumps need to be verified.

150# steam header available inside N.E. corner of 200 Area.

Possibility also exists for drawing condensate from Area 100 system.

H.A. Williams, P.E. Lowell R. Mast, P.E. Richard W. Payne, P.E.
Robert T. Roberts, P.E. Leslie L. Robinson, P.E. Jerry L. Rhoades, P.E. Raymond H. Woodward, P.E.

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Meeting Minutes - Cont'd.
Re: U.S.S. Chemicals Solar System
December 12, 1979

Page 2

6. Installation of generator outside would necessitate construction of service enclosure for protection of equipment, controls and monitoring equipment. This represents an added cost to the project as opposed to locating the generator within the 200 Area Building.
7. Design should incorporate consideration of the following:
 - a. What happens to lines or line conditions when the system is down?
 - b. Steam generator should not go cold?
 - c. When system is down, will system steam bleed or leak back through generator?
 - d. Consider bleed around line to keep lines and generators hot when system is down.
 - e. Must assure sufficient condensate is available so as not to cavitate pumps.
 - f. Solar fluid lines through plant shall have metal tray under oil lines.
 - g. Design flow rate and system to minimize amount of fluid in the system.
8. U.S.S. Chemicals to provide HAW with drawings of the following:
 - a. Areas 100, 200 and 800 buildings and utilities with 150# steam distribution of sufficient detail to show loads and how condensate gets back to receiver.
 - b. Piping and rack details through and between connecting buildings.
9. Three Collector Manufacturers are now being considered; a) Accurex, b) Solar Kinetics, c) Sun Tec. Columbia will advise choice as soon as possible.
10. Preliminary design layout should show at least schematically, 150# steam to load and condensate back to receiver (show complete logs).
11. Emergency power is not available in Building 200.

H. A. WILLIAMS & ASSOCIATES, INC.


Lowell R. Mast, P.E.

LRM/emg

cc: All Conferees



H. A. Williams and Associates, Inc.

CONSULTING ENGINEERS

December 18, 1979

MEETING MINUTES

Re : U.S.S. Chemical Solar Project
Date : December 13, 1979
Place : U.S.S. Chemical, Haverhill, Ohio
Present : Rick Warner, U.S.S. Chemical
Stan Demski, U.S.S. Chemical
Philip Dechow, Columbia Gas Service Corp.
Dave Leon, Columbia Gas Service Corp.
Lowell Mast, H. A. Williams & Assoc., Inc.

1. Solar Kinetics collectors were introduced and discussed.
2. Fluid selection was discussed. Will be further evaluated.
3. Plant personnel stated that steam tracing was used to keep heating fluids warm.
4. Various collector layouts were discussed. It was decided that collector field must be laid out for best land utilization.
5. HAW's office to submit new collector field layout to U.S.S. Chemical by 12/18/79.
6. Rick Warner will provide HAW's office with plans of water and sewer lines in the work area.
7. A mobile wash system will be used when collectors must be cleaned. U.S.S. Chemical to look into cost and availability.
8. A 3", 150 psig steam line presently runs to the Maintenance Building. This line could be used to convey steam to Building #200. Line was field verified as 2" at the Maintenance Building.
9. The plant presently drains its fluid systems into drums or tank trucks when drainage is required for servicing. Hand pumps are used to pump fluid into system from tanks.
10. Water to existing boilers is treated and deaerated. Water treatment by J. Hartley, Huntington, West Virginia, 1-304-453-6196.

H.A. Williams, P.E. Lowell R. Mast, P.E. Richard W. Payne, P.E.
Robert T. Roberts, P.E. Leslie L. Robinson, P.E. Jerry L. Rhoades, P.E. Raymond H. Woodward, P.E.

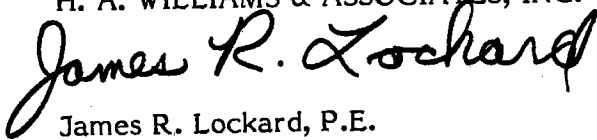
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Meeting Minutes - Cont'd.
Re: U.S.S. Chemical Solar Project
December 18, 1979

Page 2

11. Make-up water is not added to condensate receiver outside of the Utility Building.
12. There is adequate condensate in receiver to supply 18 GPM. 70% to 80% of 30,000 lbs./hr.
13. Condensate in receiver is 20 - 30 psig and is at saturation temperature.
14. HAW's office presented a rough outline of the proposed generator building and presented cost estimates for the structure of approximately \$28,000. It was confirmed by U.S.S. Chemicals that locating the generator in Area 200 Building was not a feasible alternative.

H. A. WILLIAMS & ASSOCIATES, INC.

James R. Lockard

James R. Lockard, P.E.

cc: All Conferees



H. A. Williams and Associates, Inc.

CONSULTING ENGINEERS

January 22, 1980

PROJECT MEETING NOTES

Date : January 18, 1980

Place : U.S.S. Chemical, Haverhill, Ohio

Re : U.S.S. Chemical Solar Project

Present: Mr. Stan Demski, U.S.S. Chemical
Mr. Arun Patel, U.S.S. Chemical
Mr. Bob Mershmer, U.S.S. Chemical
Mr. Al Walker, U.S.S. Chemical
Mr. James McKee, U.S.S. Chemical
Mr. Philip Dechow, Columbia Gas Service Corp.
Mr. Dave Leon, Columbia Gas Service Corp.
Mr. Lowell Mast, H. A. Williams & Assoc., Inc.
Mr. James Lockard, H. A. Williams & Assoc., Inc.

1. Floor drains from Generator Building can run to ditch. Ditch has oil skimmer at outlet. HAW will look into code problems.
2. Site survey tracing was returned to U.S.S. Chemical to have areas left off, added.
3. An oil interceptor is required for drainage tile from field.
4. Condensate line in Polystyrene Plant is from 70 - 75 psig.
5. HAW to look into location of connection of steam line and further evaluate.
6. Transfer Pumps from condensate receiver are operated continuously. Flow is controlled by a low level sensor which controls bypass control valve.
7. HAW needs drawings of standard pipe rack at Maintenance Building.
8. Vapor barriers are required on walls of "Data Room".
9. Pipe connections between rows must be installed underground to allow access to rows.
10. HAW to look into a fatigue problem with generator tubes due to warmup and cooldown, also will look into type of pump seals required for temperatures involved.
11. A steam separator must be installed on the steam outlet of the generator.

H.A. Williams, P.E. Lowell R. Mast, P.E. Richard W. Payne, P.E.
Robert T. Roberts, P.E. Leslie L. Robinson, P.E. Jerry L. Rhoades, P.E. Raymond H. Woodward, P.E.

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Project Meeting Notes - Cont'd.
Re: U.S.S. Chemical Solar Project
January 22, 1980

Page 2

12. U.S.S. Chemicals to look into special requirements for their high temperature Hydrotherm Systems and advise.
13. Plant has a 96.5% corrected power factor. HAW will design electric for Generator Building according to Class I, Division 2 requirements or locate equipment accordingly.
14. Equip building exhaust fan with H.O.A. device.
15. HAW to contact Standard Slag Co. at New Boston for information on materials.
16. HAW to determine cost of "chip and seal" surface and advise.
17. U.S.S. Chemicals to obtain requirements from insurance group and advise.
18. 17' plant standard for roadway clearance should be checked out with Rich Warner.

H. A. WILLIAMS & ASSOCIATES, INC.

James R. Lockard

James R. Lockard

JRL/emg

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H. A. Williams and Associates, Inc.

CONSULTING ENGINEERS

January 29, 1980

PROJECT MEETING NOTES

Date : January 29, 1980

Place : Columbia Gas, Columbus, Ohio

Re : Haverhill Solar Project

Present: Edward Reid - Columbia Gas
Phil Dechow - Columbia Gas
Lowell Mast - H. A. Williams & Associates
Jim Lockard - H. A. Williams & Associates

1. Phil Dechow to provide H. A. Williams with a copy of the collector quotation.
2. H. A. Williams to determine extra pipe required for a reverse return system and provide Columbia Gas with data on system losses and pumping heads for varied piping configurations.
3. Final decision was made to use a plant East West orientation with the piping as shown on Sheet M-1RR.
4. Columbia Gas to provide a graph of flow rate required versus hours to determine the best reduced flow condition.
5. A list of questions for the collector manufacturer was given to Columbia Gas. H. A. Williams to contact collector manufacturer. Questions answered by phone call with Gus Hutchinson 1/29/80.
 - a) "Does center drive pylon require same foundation bolt hole circle, etc., as other support parts?"

YES, DATA IN TECHNICAL MANUAL.
 - b) "Details of center pylon drive assembly and control box?"

SOLAR KINETICS WILL SUPPLY.
 - c) "Location of all sensors and what field wiring is required?"

TRACKING AND HIGH LIMIT MOUNTED NEAR CENTER PYLON AND COMES EQUIPPED WITH CABLE TO BE WIRED INTO CENTER PYLON CONTROL BOX. LIMIT SWITCH BUILT INTO PYLON.

H.A. Williams, P.E. Lowell R. Mast, P.E. Richard W. Payne, P.E.
Robert T. Roberts, P.E. Leslie L. Robinson, P.E. Jerry L. Rhoades, P.E. Raymond H. Woodward, P.E.

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Project Meeting Notes - Cont'd.
Re: Haverhill Solar Project
January 29, 1980

- Page Two -

- d) "What is maximum current drawn and normal pumping duration for hydraulic pump @ 0°? @ 30°? @ 70°?"

ONLY DATA AVAILABLE INDICATED 4 TO 6.5 AMPS @ 105°.

- e) "Any difficulty with pumping hydraulics at low temperatures, 0 - 10°F.?"

AUTO TRANSMISSION FLUID USED WAS ONLY COMMENT.

- f) "Complete written description and electric power and control drawings including point to point wiring from master control panel to field drive units."

DRAWINGS WILL BE MADE AVAILABLE. 3 #12 STRANDED COMMON CONTROL & 3 #8 POWER.

- g) "Data or calculations to verify wind load and torque factors for support column foundations."

PROVIDE SOLAR KINETICS WITH SOILS DATA AND GEORGE MAYS, THEIR STRUCTURAL CONSULTANT, WILL PROVIDE CALCULATIONS AND RECOMMENDATIONS FOR FOUNDATION.

- h) "How much staging area required for receipt and storage prior to erection?"

PYLONS, COLLECTORS AND RECEIVER TUBES SHIPPED IN STAGED DELIVERY. 20 COLLECTORS PER 40' FLAT BED.

- i) "Copies of manufacturing shop and assembly drawings."

HESITANT ON FURNISHING THESE, WILL SEE THAT WE GET CENTER AND END DETAILS.

- j) "Copies of installation drawings and instructions."

INFORMATION IN TECHNICAL MANUAL FAIRLY COMPLETE. THEY DO PROVIDE TECHNICIAN TO ASSIST IN SETTING UP FIRST ROW AND IN FINAL CHECK OUT OR START UP.

- k) "A packing list of all parts and method of shipping to job site. What parts are preassembled?"

SHIPPED BY TRUCK - 20 COLLECTORS PER 40' FLAT BED. WORKING ON 80 COLLECTOR SHIPMENT ON FLAT CAR (RAIL). OFF LOADING EQUIPMENT WILL PROBABLY NOT BE MADE AVAILABLE. PYLONS SHIPPED ON PALLETS. COLLECTOR TUBES SHIPPED IN BOXES 20 TO 50 PER BOX. ASSEMBLED ON SITE. TUBES SHOULD NOT BE STORED OUTSIDE AT SITE WHERE SUBJECT TO MOISTURE.

Project Meeting Notes - Cont'd,
Re: Haverhill Solar Project
January 29, 1980

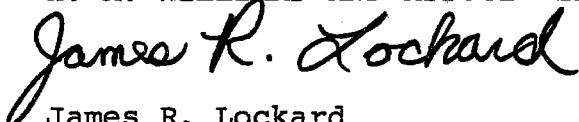
- Page Three -

GUS RECOMMENDED A VISITATION FOR HANDS ON INSPECTION OF EQUIPMENT AND REVIEW OF SPECIFIC QUESTIONS AND DETAILS. TRIP TENTATIVELY SCHEDULED FOR 2/7/80.

6. A list of questions for U.S.S. Chemical and Columbia Gas was given to Columbia Gas with a schedule for dates to have questions answered. H. A. Williams to follow up receipt of data.
7. H. A. Williams to evaluate the use of draw tile in the collector field.
8. H. A. Williams to evaluate pipe insulation underground and means to prevent heat losses at pipe anchors.
9. H. A. Williams to investigate a code variances for the deletion of the emergency make-up water supply.
10. H. A. Williams to provide Columbia with information for monthly reports by the 8th of the month.
11. H. A. Williams to determine piping and steam generator codes applicable and supply copies to Columbia Gas.
12. Detail and submit best recommended method to prevent thermal losses at pipe anchor points.
13. H. A. Williams to provide analysis and support data on selection of most efficient and practical expansion provisions. Determine pressure drop and maintenance required for flexible hose.
14. H. A. Williams to provide full technical and performance data on final selection of collector loop pumps and motors.
15. H. A. Williams to research and recommend P&ID for project.
16. H. A. Williams to complete and submit design schedule for completion.
17. Columbia Gas will not require conduit in field for future instrumentation wiring.

Very truly yours,

H. A. WILLIAMS AND ASSOCIATES, INC.



James R. Lockard

cc: Edward Reid - Columbia Gas
Phil Dechow - Columbia Gas



H. A. Williams and Associates, Inc.

CONSULTING ENGINEERS

February 11, 1980

PROJECT MEETING NOTES

Date : February 7, 1980

Place : S.K.I.

Re : U.S.S. Chemical - Solar System

Present: Gus Hutchinson
Phil Dechow
Lowell Mast

1. How is pressure drop curve affected by Synfluid or by fluid temperature and viscosity?

No test data available on Synfluid. Pressure drop not affected by temperature. Is affected by viscosity, but no test data available for low viscosity fluids. Recommend using standard calculating procedures to estimate.

Use Crane Tech paper #410 1976 "Flow of Fluids Through Valves, Fittings and Pipe" as guide. Obtain from Crane Company, 4100 S. Kedzie Avenue, Chicago, Illinois 60632, phone (312) 523 2900

2. Can 15 GPM be pumped through a collector row? What is pressure drop?

Yes in fact 15 GPM may be preferred in order to get better temperature regulation and decrease system pipe losses. Pressure drop not materially affected. Use calculation procedures as per Item #1.

3. What type of flow meters have been used on other jobs?

A turbine type meter as manufactured by Flow Technology with digital readout is probably the best. However, for balancing, temperature has most generally been used, because SK doesn't think critical balancing is necessary. Recommend using larger size headers in order to reduce the balancing problem because area can be increased with very small corresponding surface area for losses.

Do not recommend any fittings for balancing on pressure or flo.
If this is wanted use a propeller type flow meter permanently installed in piping.

H.A. Williams, P.E. Lowell R. Mast, P.E. Richard W. Payne, P.E.
Robert T. Roberts, P.E. Leslie L. Robinson, P.E. Jerry L. Rhoades, P.E. Raymond H. Woodward, P.E.

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February 11, 1980
Page Two

Project Meeting Notes
U.S. Chemical - Solar System
S.K.I.
February 7, 1980

4. What should be used for throttling or balance? Definitely do not use valves at each end otherwise you are designing a bomb. Use a valve at the inlet, probably a butterfly valve because of cost and low pressure drop. Mount valve on the plumbing as opposed to collector. Then install a check valve at the other end of system.
5. How is collector efficiency affected by outdoor temperature?
Negligible.
6. Review questions asked by phone on 1/29/80.
 - a) No change, see minutes 1/29/80.
 - b) See drawing SKC-A-06-081 D Hydraulic Components.
 - c) No change, see minutes 1/29/80.
 - d) and
 - e) Do not anticipate pumping problems since ATF is used. System is charged at factory. Does not change viscosity too much at low temperature. May require an adjustment in flow rate to compensate for low temperature (field adjustment).
 - f) Electrical schematic along with a written control scenario will be provided. We probably need to bug them on this in about 3-4 weeks. Also, see drawing for T 700 pylon control box, control, control enclosure and drive schematic (8½ x 11 sheets). Discussed separate power supplies to pumps and need to monitor power source. SKI will modify control package to monitor hydraulic pump power at terminal and if not available for any reason, will activate stow circuit.
 - g) No change, see minutes 1/29/80.
 - h) No change, see minutes 1/29/80.
 - i) Provided some drawings:
 - SKC S-06-061 C Counter Wt
 - SKF X-06-068 C Row Layout
 - SKC A-06-084 D Basic Component
 - SKC A-06-065 C End Shaft Assembly
 - SKC A-06-064 C Intermediate Shaft Assembly
 - j) See assembly drawing manual furnished.

February 11, 1980
Page Three

Project Meeting Notes
U.S.S. Chemical - Solar System
S.K.I.
February 7, 1980

7. Can piping drops to mains be supported from collector support?
Yes, on one job they fabricated a pipe support and bolted it to column.

8. Pipe connection at collector is now connected with a swedgelok fitting.
New system probably will use Eroquip coupling.

Pipe material is mild steel hydraulic tubing 16 ga. 1500 p.s.i. A.S.T.M.?

During discussion and review of the project Gus recommended the following:

- a) Oil will entrain air at low temperatures. Need to install cyclone deaerator as part of expansion tank. Put expansion tank at inlet to pump and pipe out bottom. Supply line into tank below surface. Preferrably use a tall skinney tank with level switch to shut down system when loss of fluid is indicated.
- b) Believes that the system with the lowest insulation cover per unit of aperture will be most successful.
- c) New collector design will consist of 10⁺ lengths 1½" diam. tubing straight thru run with no reductions at fittings and pre-assembled with glass envelope. No interior ribbon required at the higher flo rates and we can calculate pressure drop based on standard tubing. Use one pound drop thru each flex hose or we can specify the drop and they will design accordingly. Base our design on this equipment being available.
- d) Insulation - based upon an analysis of BTU/\$/sq.ft./O^a a combination of 1 - 1½" ceramic felt plus 1-1½" polyurethane shows the best. Big advantage is the density which will not compress and loose support as does fiberglass. Also, does not have thermal mass of calcium cilicate type insulation to overcome.

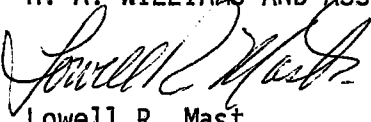
Cerfelt rigid formed pipe insulation by Johns Manville on Kao-felt good for 600⁰ and good R factor.

For waterproofing (underground) recommends urethane with manually applied weatherproof mastic. Has not yet seen an aluminum cover which was watertight and too expensive to install because of short lengths. Follow chilled water technology.

- e) Testing of receiver assembly probably should be done with air at 500 p.s.i. using standard test dope (bubble test).

Respectfully submitted,

H. A. WILLIAMS AND ASSOCIATES, INC.



Lowell R. Mast

LRM/cr

February 22, 1980

PROJECT MEETING NOTES

Date : February 21, 1980
Place : U.S.S. Chemical, Haverhill, Ohio
Re : U.S.S. Chemical Solar Project
Present : Stan Demski- U.S.S. Chemical
Al Walker- U.S.S. Chemical
James McKee- U.S.S. Chemical
Arun Patel- U.S.S. Chemical
Bob Mershimer- U.S.S. Chemical
Rick Warner- U.S.S. Chemical
Philip Dechow- Columbia Gas Service Corp.
Dave Leon- Columbia Gas Service Corp.
Scott Phelps- Columbia Gas Service Corp. of Portsmouth

1. Electrical switchgear should be installed in Data Acquisition room.
2. Cool down water will not be required on blowdown separator. Condensate from separator can be discharged directly to drainage ditch.
3. H.A. Williams and Associates to look into water requirements for cooling jackets on pumps.
4. Al Walker feels pumps should be mounted outside the generator building. Stan Demski stated that if U.S.S. Chemical was designing project, the pumps would be mounted outside.
5. Ultrasonic flow meters were discussed as a means of system balance.
6. If deionized water is required by a collector cleaning crew, it can be obtained at the rear of Building # 200 and does not need to be piped to the generator building.
7. The steam separator installed internally in the steam generator was discussed. Plant personnel feel that an externally mounted separator is required.

Project Meeting Notes- Cont'd.
Re: U.S.S. Chemical Solar Project
February 22, 1980

Page 2

8. Exterior insulation jackets should be aluminum or stainless steel.
9. Solar fluid piping should be evacuated before filling with fluid to remove all moisture and air.

Respectfully submitted,

H. A. Williams & Associates, Inc.

J. R. Lockard

JRL/ve

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H. A. Williams and Associates, Inc.

CONSULTING ENGINEERS

March 3, 1980

PROJECT MEETING NOTES

Date : February 29, 1980
Re : Haverhill Solar Project #79199
Place : Columbia Gas Systems Service Corporation
Present : Mr. Phil Dechow, Columbia Gas System Service Corp.
Mr. Lowell R. Mast, H. A. Williams & Assoc., Inc.

1. HAW received from Columbia the requested Preliminary Design Review Notes and SKI proposal (both attached).
2. Columbia will furnish instrumentation locations and equipment cuts by Tuesday, March 4.
3. Next meeting of team at Haverhill on March 20, time to be set up. Columbia - HAW review meeting at HAW at 3:30 P.M., on March 11 and April 1st. HAW to remind Phil in advance of above dates.
4. HAW can use spec. format similar to Highlights Building.
5. Collectors could be furnished by Contractor or by Columbia at HAW discretion. Concern expressed by HAW is with the added \$1 M contract sum, the smaller contractors may not be able to get bond. Interest and cash flow costs plus overhead and profit could be extensive. This concern is countered by the advantage of one person responsibility, although SKI may not be as agreeable to holding close to original price quotation.
6. May be required to send 80% sets, including specifications, to DOE by April 2.
7. HAW to get Phil actual \$ extra cost for reverse return system (Analysis sheet ref. Item 4) next week.
8. HAW should also note DOE's objection to fiber insulation (see Item 12 E.T.E.C.) and with two objections (E.T.E.C. and SKI) have some pretty good reasons for using same.
9. HAW to have up-graded estimate to Columbia by March 28 for their final economic study.

H.A. Williams, P.E. Lowell R. Mast, P.E. Richard W. Payne, P.E.
Robert T. Roberts, P.E. Leslie L. Robinson, P.E. Jerry L. Rhoades, P.E. Raymond H. Woodward, P.E.

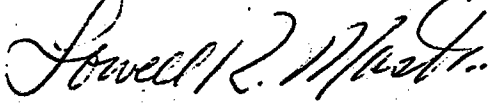
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Project Meeting Notes - Cont'd.
Re: Haverhill Solar Project #79199
March 3, 1980

Page 2

10. HAW to expedite the obtaining of cleaning equipment, fire protection information, site survey and soil borings from U.S.S. Chemicals, and the electrical control descriptive sequence, schematic diagrams, product specification data, and structural foundation data from SKI.
11. HAW to consider and include in spec. the desirable spare parts. Among these things to include:
 - (Ten) - 10' absorber assemblies
 - (Two) - Control logic boards
 - (Two) - Delavin Sun-Lok I tracker units with sensor
 - (Ten) - Flex hose assemblies
 - Gaskets, seals, etc.???
12. HAW to get Phil a price on professional (Howard) color rendering of plant next week.

H. A. WILLIAMS & ASSOCIATES, INC.



Lowell R. Mast

LRM/emg

DISTRIBUTION:

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- 1 - T. E. Huff, HAW
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- 1 - C. R. Gallogly, HAW
- 1 - M. I. Gelderloos, HAW
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H. A. Williams and Associates, Inc.

CONSULTING ENGINEERS

March 12, 1980

PROJECT MEETING NOTES

Date : March 11, 1980

Place : Office of H. A. Williams & Associates, Inc.

Re : Haverhill Solar Project

Present: Mr. Phil Dechow, Columbia Gas System Service Corporation
Mr. Dave Leon, Columbia Gas System Service Corporation
Mr. Clarence Gallogly, H. A. Williams & Assoc., Inc.
Mr. Tom Huff, H. A. Williams & Assoc., Inc.
Mr. Mark Gelderloos, H. A. Williams & Assoc., Inc.
Mr. James Lockard, H. A. Williams & Assoc., Inc.

1. Informed Phil that we had received some wiring diagrams from Solar Kinetics on March 10th. We are still waiting on a control scenario. Gus Hutchinson said he would send it as soon as it is finished by typesetter.
2. CRG discussed rendering with Phil. A retouched photo may be used.
3. Informed Phil that we had not yet received survey and that I had called Rick Warner both Monday and Tuesday and he had not returned my call.
4. MIG has received preliminary soil data by phone and will have to make footers either 7' or 10' deep, depending on final test data.
5. TEH discussed electric control system for field. It was decided that if we had room in Data Room for Field Control Panel, it should be installed indoors. Phil decided that a Status Panel, that would show if each row is in Stow, will not be required on this project.
6. Phil accepted our idea for a low loss pipe anchor.
7. The Columbia Gas Data Acquisition Equipment will have sensor in the field to monitor temperatures for each row. It was then decided that these sensors could be used for balance.

Project Meeting Notes - Cont'd.
Re: Haverhill Solar Project
March 11, 1980

Page 2

8. Dave Leon will deliver flow and temperature sensor locations to H. A. Williams & Associates on 3/12/80.

Respectfully submitted,

H. A. WILLIAMS & ASSOCIATES, INC.

James R. Lockard

James R. Lockard

JRL/emg

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H. A. Williams and Associates, Inc.

CONSULTING ENGINEERS

March 21, 1980

PROJECT MEETING NOTES

Date : March 20, 1980
Place : U.S.S. Chemical, Haverhill, Ohio
Re : U.S.S. Chemical Solar Project
Present : Stan Demski - U.S.S. Chemical
Al Walker - U.S.S. Chemical
James McKee - U.S.S. Chemical
Bob Mershimer - U.S.S. Chemical
Rick Warner - U.S.S. Chemical
Philip Dechow - Columbia Gas Service Corp.
Dave Leon - Columbia Gas Service Corp.
Tom Huff - H. A. Williams & Associates
Jim Lockard - H. A. Williams & Associates

1. Structural calculations should be included in design book and a copy of structural calculations should be sent to Phil Dechow by March 25.
2. The title of each sheet should be above the title block.
3. Phil Dechow objects to the use of stampats on drawings.
4. Pipe rack supports should be galvanized.
5. Flow arrows should be added to sheet M-1.
6. Expansion loops should be considered on boiler feed water lines.
7. Al Walker feels boiler feed pumps should run continuously with a modulating control valve to regulate feed water to steam generator. H. A. Williams will answer by letter.
8. P & ID diagram needs to have valves and control circuitry shown. An example was given to H. A. Williams.
9. A hand off auto switch should be used at boiler feed pumps. Boiler feed should automatically switch over to backup during failure of primary pump.
10. Boiler feed pumps should be named steam generator feed pumps.

H.A. Williams, P.E. Lowell R. Mast, P.E. Richard W. Payne, P.E.
Robert T. Roberts, P.E. Leslie L. Robinson, P.E. Jerry L. Rhoades, P.E. Raymond H. Woodward, P.E.

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Project Meeting Notes - Cont'd.
Re: U.S.S. Chemical Solar Project
March 21, 1980

Page Two

11. Steam separator should have a trap discharging into the blowdown separator and should be installed downstream of the automatic stop check.
12. Pump, vessel and motor control center numbers should follow U.S.S. Chemical Plant sequence. U.S.S. Chemical to supply numbers to H. A. Williams.
13. U-1 forms must be submitted for pressure vessels with operating and maintenance manuals.
14. H.A. Williams to look into results of using deionized water in the steam generator.
15. A separate drain line must be run from the floor drain to the ditch.
16. U.S.S. Chemicals suggested moving blowdown separator outside.
17. Wells for sensors furnished by Columbia Gas.
18. Flash chambers are not required on steam traps.
19. Steam flow meter must be located downstream of branch to unit heater.
20. U.S.S. Chemical to look into need for underground conduits to be encased in concrete.
21. Lighting is required outside of building in pump area.
22. U.S.S. Chemicals suggested using sodium lighting.
23. Steam generator building should be the same color as existing buildings on plant site.
24. Solar collectors will be furnished by Columbia Gas.
25. Existing fences are U.S.S. Cyclone.
26. Answers have not been received on cleaning equipment or insurance requirements.
27. General conditions were discussed. U.S.S. Chemicals to provide their recommendations to H. A. Williams.
28. A pre-bid meeting will be held.
29. The Contractor must follow U.S.S. Chemicals safety and security requirements. They will be discussed in the pre-bid meeting.
30. H. A. Williams to provide Columbia Gas with an updated set of plans March 28, 1980.

Project Meeting Notes - Cont'd.
Re: U.S.S. Chemical Solar Project
March 21, 1980

Page Three

Respectfully submitted,

H. A. WILLIAMS AND ASSOCIATES, INC.

James R. Lockard

cc: Each Conferee
Mark Gelderloos, H. A. Williams & Associates
Clarence Gallogly, H. A. Williams & Associates

lp



H. A. Williams and Associates, Inc.

CONSULTING ENGINEERS

980 West Henderson Road • Columbus, Ohio 43220 • Telephone (614) 451-1711

April 2, 1980

PROJECT MEETING NOTES

Date : April 1, 1980
Place : U.S.S. Chemical, Haverhill, Ohio
Re : U.S.S. Chemical Solar Project
Present : Philip Dechow, Columbia Gas Service
Lowell R. Mast, H. A. Williams & Assoc., Inc.
Clarence R. Gallogly, H. A. Williams & Assoc., Inc.
James R. Lockard, H. A. Williams & Assoc., Inc.

1. Phil Dechow approved cover for design analysis. 25 covers will be printed.
2. The color of the steam generator building will be selected by Owner when shop drawings are processed.
3. Information has not been received from U.S.S. Chemicals about system cleaning service or fire protection, and insurance requirements.
4. Alternate building manufacturers should be included in Specifications.
5. HAW will send copies of collector support post calculations to Solar Kinetics for review.
6. HAW to send P & ID Diagram to U.S.S. Chemicals for approval on or about April 8, 1980.
7. HAW requested Columbia's insurance requirements from Phil Dechow.
8. HAW to have all documents for submittal to D.O.E. and project team for review on April 14, 1980.
9. Next project meeting at U.S.S. Chemicals on April 21 or 22, 1980. Phil Dechow to advise.

Respectfully submitted,

H. A. WILLIAMS & ASSOCIATES, INC.

James R. Lockard
James R. Lockard

JRL/cr

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H. A. Williams and Associates, Inc.

CONSULTING ENGINEERS

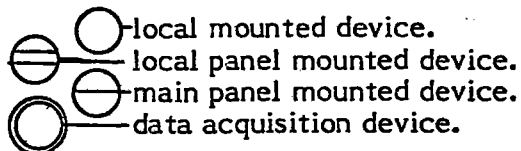
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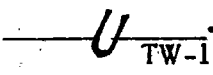
April 29, 1980

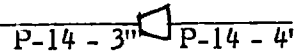
PROJECT MEETING NOTES

Date : April 24, 1980
Place : USS Chemicals, Haverhill, Ohio
Re : USS Chemical Solar Project
Present : Stan Demski - USS Chemicals
Al Walker - USS Chemicals
James McKee - USS Chemicals
Bob Mershimer - USS Chemicals
Rick Warner - USS Chemicals
Philip Dechow - Columbia Gas Service Corp.
Ed Reid - Columbia Gas Service Corp.
Lowell Mast - H. A. Williams & Associates, Inc.

1. For identification purposes, we are to use 1300 (13) as an area designation for the solar project.
2. USS Chemicals distributed Polystyrene Flowsheet Symbols (6 of 6), Polystyrene Line Service Designations (1 of 1), and Equipment Designations (1 of 1) for our use.
3. We should include wiring for an alarm circuit to be extended into annunciator panel in wet side control room on second level of Polystyrene plant in vicinity of Column E-3. USS Chemicals will make final connections and will advise if spare wiring exists for connection closer to solar field than Column E-3.
4. In a review of Sheet M-7, USS Chemicals made the following recommendations:
 - A. Review all control devices to eliminate redundancy.
 - B. TAH is improperly located.
 - C. TC 102 loop is not properly identified and is not functional without an intermediate control panel.
 - D. Revise symbolism as follows:



- E. Review low water cutoff to be representative of specific operation; what is the switching and control device?
- F. Use same symbols for control piping and wiring as USS Chemicals.
- G. Add line numbers to all piping. All piping and valves to be shown, including drains, vents, tees, blow down, reducers, by-passes, etc.
- H. Do we need two PSV's and two sight glasses by code? A pneumatic low water cut-off may not normally include sight glass.
- I. We can eliminate one PC on boiler feedwater. This should be shown controlling a control valve in condensate line.
- J. Must have a relief valve to protect condensate pumps in case of blocked valve.
- K. P & ID must show drain valves on pumps. May possibly show as typical in aside.
- L. We should discuss and verify need for two separate water (alarm) columns.
- M. USS Chemicals requested pneumatic feedwater control. HAW to check specification to see that it reads as such.
- N. Need a low water cut-off on BFW pumps. Show condensate receiver on drawing and applicable controls applied.
- O. Do we have blow-down for water columns?
- P. Show generator blow-down, add line numbers.
- Q. We need a PSV on main line around block valve.
- R. Rather than acquisition devices, maybe we should only show T's or wells

- S. Locate a free blow line on steam generator supply line ahead of each block valve.
- T. Show vents and note where they terminate.
- U. Need two PSV's on generator.

- V. How do we control suction pressure on pumps through air separator?
Any air lines or vents off of separator?
- W. Add a nitrogen bottle with PRV and fittings permanently piped.
- X. Show pipe reducers in lines where they actually occur. 
- Y. More specific data required on P & ID in regard to purchased control packages or reference to manufacturer's drawings. Copies included for USS Chemicals' use.
- Z. Where is air (N₂) separator described in specifications?
- AA. USS Chemicals requires detailed operating and maintenance manuals which identifies:
1. General Description of Entire System
 2. Detailed Valve by Valve and Step by Step Procedure for Start-Up, Shut-Down, and Emergency Procedures.
 3. An Appendix with P.I.D., Flow Equipment List, etc.
- A mechanical manual of vendors list, equipment shop drawings, maintenance instructions, etc., is also required.
- This will be discussed by Columbia and HAW to determine what part would be in Phase I and what part to be in Phase II.
- BB. How can the Owner take water samples at the boiler?
- CC. How can the size of the project justify an air compressor for control air? Did we consider an electric operated aspirator type device?
- DD. HAW to consider and note fail safe logic on all controls.
- EE. Graphic representation for displacement pumps to be different than centrifugal.
- FF. Temperature devices must be designated as a switch, or transmitter, or controller and noted as to analog or digital.
- GG. Provide protection in all cases against closed valves.
- HH. Add block valve in condensate to boiler side of feedwater control valve.
Also consider adding manual by-pass.
- II. P & ID drawings shall include set points for all devices, controllers, etc.

5. USS Chemicals verified that feed water supply to the project was not to be our problem.
6. Columbia offered the following comments and questions:
 - A. EPA has approved drainage as shown.
 - B. On Sheet A-2, need a window in wall and door between generator room and acquisition room.
 - C. Consider increasing depth of acquisition room by 5' or relocating expansion tank to make more room for visitors, building has gotten too small.
 - D. Show floor drain on Architectural Drawing and Mechanical Drawing.
 - E. On Sheet S-1, clarify maximum and minimum on collector support. Take out fence.
 - F. Discussed need for wider access for maintenance. USS Chemicals to provide Columbia with size and capability of specific service organization. Who will be doing cleaning?
 - G. What is insulation type shown in prefabricated piping on Sheet M-2? Is there any wicking type insulation on the job?
 - H. What is to prevent steam generator from going into a vacuum condition and how do we recommend prevention or protection?
 - I. Change reference on M-3 from boiler feedwater to steam generator feed water.
 - J. Why isn't H&A/C Unit a heat pump? It should be, by nature of project.
 - K. Add safety shower in southwest corner.
7. USS Chemicals questioned capability of Patterson Kelly equipment to perform in this environment in trouble free manner.
8. Relief valves must be piped outside. Do not need to go to drain, provide weep hole at bottom of rise.
9. USS Chemicals will come to Columbus on Thursday, May 1, to review and assist in development of P & ID drawings.

Project Meeting Notes - Cont'd.
Re: USS Chemicals Solar Project
April 29, 1980

Page 5

10. USS Chemicals will review General Conditions and Supplementary Conditions for compliance and will verify fire protection requirements.
11. USS Chemicals still not clear regarding need for conduit encasement.

Respectfully submitted,

H. A. WILLIAMS & ASSOCIATES, INC.



Lowell R. Mast, P.E.

LRM/emg

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H. A. Williams and Associates, Inc.

CONSULTING ENGINEERS

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May 7, 1980

PROJECT MEETING NOTES

Date : May 1, 1980
Re : Haverhill Plant Solar Project
Place : Office of H. A. Williams & Assoc., Inc.
Present : Mr. Al Walker, USS Chemicals
Mr. Rick Warner, USS Chemicals
Mr. Phil Dechow, Columbia Gas System Service Corp.
Mr. Lowell Mast, H. A. Williams & Assoc., Inc.
Mr. Jerry Rhoades, H. A. Williams & Assoc., Inc.
Mr. James Lockard, H. A. Williams & Assoc., Inc.

1. Al Walker and Rick Warner reviewed the P & ID diagram. The P & ID diagram was then discussed. HAW to make corrections required and resubmit.
2. HAW to look into procedure for evacuating system before filling with fluid.
3. HAW to look into acquiring 25 color photos of steam generator for final report.
4. All underground conduit must be encased in red concrete.
5. Provide rupture disc under all pressure relief valves.
6. Replace flow control valve at steam generator feed pumps with minimum flow orifice.
7. A corrosion coupon will be installed in the feedwater line. Rick Warner to inform HAW of size of connection required for coupon. Coupon provided by USS Chemicals.
8. A compressed CO₂ fire extinguisher should be used in Data Room.

If you have any questions on the above, please call.

Very truly yours,

H. A. WILLIAMS & ASSOCIATES, INC.

James R. Lockard
James R. Lockard, P.E.

JRL/emg

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DOE - HAVERHILL SOLAR REVIEW MEETING NOTES
MAY 21 AT DOE IN SAN FRANCISCO

1. Under maintenance and operation procedures we must address the cleaning procedure and experimentation on spray pattern and pressure for best cleaning. Must address draining of water system under emergency shut-down provisions (power loss). Must address allowing system to cool down before starting maintenance procedure. Also consider possible testing of fluid for water periodically and drawing a vacuum on the system. See USS Chemicals for existing procedure.

Operation Manual to include procedure for storing during plowing season - recommend both spring and fall washing schedule during peak agricultural activity.
2. Non-drive pylons are over-designed. HAW to re-evaluate the savings of uniformity over smaller design options.
3. Pipe supports are shown on M-1 that are not on S-1. Coordinate.
4. All piping to go above ground.
5. Reviewers are concerned regarding Syn Fluid Leakage and possible air pockets in System, use of screwed fittings, leakage through check valves, compatibility of carbon steel pipe and bronze fittings.

HAW to reconsider all of above and if all welded design is adopted, maybe could go to block valve at each end with a pressure relief in each run. Need to study cost ramifications.

Generally, leakage and air entrapment were the only critical issue in the above concerns since we addressed the rest as maintenance procedures.
6. HAW to direct all valve stems horizontal or down to eliminate water leakage in and to isolate oil leaking out.
7. HAW to make available the cost difference between foam glass and fiberglass insulation.
8. Rupture disks in PRV's can be a problem, decided to leave in and remove if problem.
9. HAW will be required to prepare much more detailed start-up and fill procedures and procedures for testing of system, per Stan's comments. How to pressure test portions of system when opened for maintenance should be addressed.
10. Need to pick up valves and other devices on M-3 which are now shown on M-7.
11. DOE is concerned about collector hoses in torsion and are to discuss this with Gus.

12. Discussion of flow meters centered around type to be used and problems of calibration. The design or need of a possible by-pass around flow meter to allow for replacement and repair and the design of a pipe section with orifice plate for balancing and then removal and insertion of flow meter. Discuss with Phil.
13. 20th of June final design draft and report due, 11th July response and final submittal due July 30.
14. DOE may want us to go out for bids in 30 days (June 20th?). Need to commit FY80 funds by October.
15. Include Audit Form in General Conditions and advise Contractor of need for any sub-contracts over \$250,000. Phil to get us copy.
16. Phil to send us copy of Sandia's Fire Report at Willard.
17. HAW to expedite generator manufacturer's letter. - *Thermodyphonics*
18. HAW to re-examine building to allow installation of equipment to permit ³ pipe diameters straight run upstream of flow meters and 3 diameters downstream. Several thought our building was too tight.
19. HAW to examine cost savings or excesses if drive motors were 480, 3 phase.



H. A. Williams and Associates, Inc.

CONSULTING ENGINEERS

980 West Henderson Road • Columbus, Ohio 43220 • Telephone (614) 451-1711

June 2, 1980

PROJECT MEETING NOTES

Date : May 29, 1980

Place : USS Chemicals, Haverhill, Ohio

Re : USS Chemicals Solar Project

Present : Stan Demski, USS Chemicals
Al Walker, USS Chemicals
Rick Warner, USS Chemicals
Bob Mershimer, USS Chemicals
Philip Dechow, Columbia Gas System Service Corp.
Lowell R. Mast, H. A. Williams & Assoc., Inc.
James R. Lockard, H. A. Williams & Assoc., Inc.

1. All piping in field can be above ground. There is no need for service vehicle access.
2. Welded valves and fittings must be used in piping of fluid system. Equipment connections can be flanged for removal.
3. Bypasses will not be required around flow meters.
4. Stan Demski provided HAW with a list of qualified bidders.
5. Rick Warner will get a marked up Supplementary Conditions and General Conditions to HAW by June 6, 1980. Columbia Gas will get insurance requirements to HAW by same date.
6. An extra sight glass and relief valve is not required on the steam generator.
7. The second relief valve can be removed from the solar supply line.
8. HAW to prepare a list of air vents for D.O.E.
9. Operating and Maintenance Manuals will be prepared in Phase II.
10. USS Chemicals will supply HAW with hydrotherm start-up requirements.
11. P&ID comments from previous meeting were discussed. Items that were corrected are not listed in meeting notes.
12. USS Chemicals will supply HAW with hydrotherm flushing recommendations.
13. Floor drains must be shown on Architectural Floor Plan.
14. Install emergency shower in Steam Generator Room.

Project Meeting Notes - Cont'd.
Re: USS Chemicals Solar Project
June 2, 1980

Page 2

15. A window should be installed in wall between Steam Generator Room and Data Acquisition Room.
16. Building will be lengthened 5'-4".
17. Foamglass insulation will be used on fluid piping system.
18. A heat pump will be used to heat and cool Data Acquisition Room.
19. The Contractor must provide his own temporary road and parking area.
20. The fence must be installed around the work site as soon as grading is complete.
21. A CO₂ extinguisher must be used for Data Room. Extinguisher must be installed on exterior next to doors.
22. HAW will go ahead with fire extinguishers as the only fire protection to keep project moving, per Stan Demski.
23. All electrical conduit below grade must be in red concrete.
24. D.O.E. 80% meeting comments were discussed.
25. Rick Warner will supply HAW with information on rupture discs.
26. A spare spool piece is required for each flow meter.
27. Flow meters must have 8 pipe diameters upstream and 3 pipe diameters downstream to any elbows or valves.
28. HAW to figure price difference for using 480 volt motors.
29. Bidders conference is set for Tuesday, July 8, 9:30 A.M., at USS Chemicals.
30. Rick Warner will provide HAW with Pre-Bid Conference Notes.
31. Contract Award Date October 1, 1980. Completion date April 30, 1980.
32. A Performance Bond will not be required.

Respectfully submitted,

H. A. WILLIAMS & ASSOCIATES, INC.

James R. Lockard
James R. Lockard, P.E.

JRL/emg

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