AETRON-BLUME-ATKINSON

INTEROFFICE MEMORANDUM

3 March 1964

TO: R. Gould - SLAC (20)

FROM: L. W. Swanson

SUBJECT: TARGET AREA, LCW PIPING, MATERIALS EVALUATION REPORT, ABA-94.

During the course of conceptual engineering of the LCW piping systems for the Target Area, several suitable materials came to light. The attached report, ABA-94, summarizes the findings.

From all we have discovered to date, the epoxy-lined asbestos cement pipe appears to be a suitable material for the LCW service. The economic view of the epoxy-asbestos pipe shows a project savings of over $110,000 as compared to a stainless-steel piping system.

In view of the apparent suitability of the material, and the large potential cost saving, we strongly recommend you consider the use of epoxy-lined asbestos cement pipe for the LCW system in the Target Area.

We will be glad to meet with you to discuss the report. If additional information shows up we will pass it along for your consideration.

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LWS/ajz

DESIGN EVALUATION REPORT

ON

PIPING MATERIALS FOR THE

LOW CONDUCTIVITY WATER SYSTEM

IN THE TARGET AREA

REPORT TO STANFORD LINEAR ACCELERATOR CENTER - ABA NO. 94

STANFORD UNIVERSITY - ABA SUBCONTRACT S-136

UNDER STANFORD - AEC CONTRACT AT(04-3)-400

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PURPOSE

As a supplement to the report on Target Area Site Improvements and Utilities, ABA-86, this report details preliminary findings related to the compatibility, feasibility and economics of alternate piping materials for the low conductivity water (LCW) system proposed for the target area.

RECOMMENDATION

It is recommended, considering the economics and the physical properties of the materials, that the use of epoxy lined asbestos cement, or fiberglass be given serious consideration for the LCW systems.

COST COMPARISON

A detailed evaluation was made considering mill shipments, fabrication methods, and installation. The study resulted in the following estimated installed costs for the approximate quantities of pipe involved in the LCW system.

Type 304, stainless steel	$180,000
Aluminum, Type 6061	$151,000
Fiberglass	$142,000
Epoxy lined asbestos cement	$ 63,000

The above figures are for comparison only and include only the 4 inch and larger piping. Prices of valves and fittings are not included, but joints, anchors, trenching, corrosion protection where required are included.

The breakdown of the costs for the piping of the various materials have been prepared and are shown in chart and graphic form in Figures

one through four, attached.

Figure 1 shows graphically the cost per foot of pipe made from the materials considered.

Figure 2 shows the direct material "M", and labor "L", costs per foot for the various piping materials.

Figure 3 shows direct and indirect costs per foot, and for the quantities used as a basis for this report.

Figure 4 charts the installed costs per foot shown on Figure 3.

DESIGN CRITERIA

For purposes of design criteria the operating conditions of the system may be stated as follows:

1. The low conductivity water supply capability is 6,130 GPM at 300 psig at 95° F.

   The return capability is 6,130 GPM at 300 psig at 124° F.

   Although not included in this report, consideration is being given to the use of 150 psig piping for the return system.

2. The materials used shall be relatively passive or inert to reactions from LCW, at least to such a degree as will enable the treating equipment to keep the system "polished".

3. The system shall be designed with adequate protection from the effects of contamination, corrosion, oxidation, and erosion.

4. The intended use of high-ratio gear-operated butterfly valves will tend to protect the system from shock stresses caused by rapid deceleration of the water mass.

5. Internal erosion with its resultant contamination shall be minimized by sizing the lines to limit the velocity to less than 10 feet per second.

6. Sizing of piping mains shall be based on present demand without allowance for future expansion.

PIPE QUANTITIES

The sizes and estimated footage of LCW piping (4" and above) required in the target area is tabulated below. These quantities were used as a basis for the cost comparisons shown, and may not represent the actual lengths required in the final design.

Diameter	Lineal Footage
4 inch	460 feet
6	200
8	1580
10	1890
12	380
14	290
16	1430

DISCUSSION

Piping materials considered as being compatible with LCW and with suitable physical qualities, include the following:

1. Saran lined steel pipe, Sch. 40
2. Polypropylene lined steel pipe, Sch. 40
3. Penton lined steel pipe, Sch. 40
4. Type 304 ELC, stainless steel, Sch. 10
5. Filament wound fiberglass reinforced polyester
6. Random rove fiberglass reinforced polyester
7. Aluminum, Type 6061

8. Copper

9. Epoxy lined asbestos cement

Of the above saran, polypropylene and penton lined carbon steel are commercially available only in sizes 8 inch and smaller at costs prohibitively high compared to other materials. Also copper would be suitable only for small sizes because of the high cost of large diameter piping.

The available materials economically suitable for the main piping in sizes up to 16", are limited to:

1. Type 304 stainless steel.
2. Fiberglass reinforced polyester.
3. Aluminum.
4. Epoxy lined asbestos cement.

Stainless steel prices are based on shipment direct from the mill in car load lots, F.O.B. west coast fabricator. To gain this advantage the overall schedule must allow the contractor the necessary lead time, between order and shipment of about 60 days.

Stainless steel prices include annealing of low carbon material after longitudinal and transverse mill welding. This was suggested but may not be required. Annealing adds about 3 percent to the pipe cost.

Stainless steel prices include only normal mill quality control. Should radiographic or similar testing be required the price would have to be raised to compensate.

Several of the suppliers of alternate materials have stated that, contrary to popular belief, stainless steel is not the ideal material for handling high purity water in that metallic ions are released into the

water in amounts which, in a system of this size, may be detrimental. On the other hand the claims of the representatives of the alternate materials as to the superiority of their products should be carefully evaluated. The manufacturers are reputable, but properties of materials that affect water quality vary with conditions of service; and test results, which can be stated in different ways, may be misinterpreted. It is understood that variations of ingredients in the polyester, and possibly in the epoxy are possible. If even minute amounts of certain elements are harmful, the manufacturer may provide substitute ingredients to minimize the possibility of contamination. They will supply test information relative to their products, on request. The following list shows the principal suppliers most of whom were contacted in the course of this study.

LIST OF MANUFACTURERS

Potential material suppliers or material suppliers contacted include the following:

For Type 304 ELC stainless steel:

Ladish Company

Esco Company

Trent Tube Company

For aluminum:

Aluminum Company of America

Olin Aluminum

Reynolds Aluminum Supply Company

For fiberglass:

Amercoat Corporation

Diversified Plastics Inc.

Pittsburg Plate Glass Company, Fiberglass Division

For epoxy lined asbestos cement:

Johns-Manville Corporation