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This document classified by

E. L. Etheridge

BUDGET STUDY
PROCESS WATER TREATMENT FOR
REACTOR EFFLUENT ACTIVITY CONTROL

By

E. L. Etheridge
Plant Design
Facilities Engineering

February 25, 1966

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BUDGET STUDY
PROCESS WATER TREATMENT FOR
REACTOR EFFLUENT ACTIVITY CONTROL

I. INTRODUCTION

The purpose of this study is to provide budgetary data for modifying and monitoring the present water treatment process at B, C, D, KE, and KW reactor plants to effect a reduction in the activity of the reactor effluent water discharged to the Columbia River. The study is subdivided into three parts: 1) facilities for sodium silicate addition at each reactor water plant, 2) on-plant facilities for the manufacture and supply of sodium silicate, and 3) instrumentation for monitoring the water treatment process for standardizing water quality in the water treatment plants.

While the present concentrations of radionuclides discharged to the river are well below the maximum permissible concentrations established by the National Bureau of Standards, the proposed reduction is in the interest of providing greater protection from potential radiation exposure to people living downstream from the Hanford Plant where economically practicable.

II. STATEMENT OF THE PROBLEM

Since startup of the original reactors, a continuous effort has been exerted in minimizing the radionuclides reaching the Columbia River from reactor effluent water. Any modification to the water treatment process is thoroughly tested, with particular attention as to the effect upon reactor effluent activity, before incorporation into the water treatment process. In this manner, control of radionuclides released to the river has been effectively maintained with the concentrations of the radionuclides in the river well below the permissible concentration limits as the water reaches the downstream boundary of the Hanford Reservation.

During the past 5 years, a concentrated research and development program has been underway to discover and develop methods capable of further reducing the amount of radionuclides discharged to the river. Both pre and post-reactor processes have been investigated with some pilot plant testing conducted. The results of the program, to date, indicate there are several candidate processes available and that, in general, pretreatment process installation costs are modest but have high operating costs while installation costs of post-reactor processes are high but have low operating costs. The work also revealed that, while laboratory, single tube, and pilot plant testing establishes general trends to be expected from a process, a large scale test, half-plant test at the minimum, is necessary to discover subtle side effects which might hinder reactor operations. Development costs are therefore high before a process can be developed to the point where it can be implemented on plant-wide basis.

Other aspects that tend to cloud the picture are that there are no criteria available to establish a monetary value in reducing the amount of radionuclides discharged to the Columbia River. In addition, RL00-AEC has requested that the research and development program be confined to

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pretreatment processes that eliminate and/or reduce the (1) source or radio-activity and which can be immediately placed in service.

The pretreatment process of the addition of sodium silicate to the reactor process water has been developed to the point where it can now be implemented on plant-wide scale. A half-plant test at D Reactor has been underway since January 15, 1965, and is tentatively scheduled for completion on March 1, 1966. Interim (2,3) results of the test in the reduction of reactor effluent activity are:

<u>Radionuclide</u>	<u>Average Factor of Reduction</u>
Phosphorus-32	2
Arsenic-76	5
Chromium-51	5
Neptunium-239	4
Sodium-24	Increase by 2

Side effects of the process which were discovered:

1. Tube Filming - It was noticed when the inlet water temperature was below 10°C, film formation in the fringe tubes with thoria loadings caused Panellit pressure increases averaging 0.5 psig per day.
2. Rear Face Radiation - Exposure levels were increased two to three times higher.
3. Corrosion - Uniform corrosion was lower but pitting was more pronounced for both aluminum and carbon steel.

The above side effects of sodium silicate addition appear to be tolerable with respect to reactor operation; but the higher rear face exposure rates will require additional reactor operating personnel unless the radiation levels can be economically reduced. Exposure received from rear face work constitutes approximately 50 percent or more of the total exposure received with reactor operating and maintenance personnel. However, as indicated above, the addition of sodium silicate does produce a substantial reduction in the amount of biologically significant radionuclides discharged to the river.

If the addition of sodium silicate is incorporated into the water treatment process, the supply and delivery of sodium silicate to the reactor plants, assuming an addition feed rate of 20 ppm as SiO₂, will approximate 90,000 tons per year. Freight rates from the nearest supplier and necessary plant storage facilities substantially adds to the overall cost in

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- (1) Letter, A. B. Greninger from J. E. Travis, "Reactor Effluent Disposal Inland Canal and Lake System," January 22, 1965.
 - (2) Personal communication, R. G. Geier, January 13, 1966.
 - (3) RL-REA-2546, "Interim Report I, Production Test IP-728, Half-Plant Sodium Silicate Test," R. G. Geier, September 16, 1965.

implementing the sodium silicate addition process. The manufacture of sodium silicate on plant for immediate use would reduce the overall cost of process. A new sodium silicate manufacturing process has been developed in industry which, if utilized at Hanford, would allow utilization of existing excess reactor plant buildings and utilities in providing a facility for the production of sodium silicate on plant. The second part of this study considers the economical aspect of on-plant sodium silicate production.

The third part of the study considers improved reactor effluent activity control and possible reduction by means of instrumentation. The present control of the water treatment process consists of monitoring the pH of the finished water, the temperature of the bauxite reaction, and the turbidity of the treated water. Chemical additives, other than sulfuric acid for pH adjustment, are constant throughout the year, with sodium dichromate at 1 ppm and the coagulant, aluminum sulfate, at 18 ppm. This treatment produces a satisfactory coolant with optimum and essentially constant reactor corrosion and filming characteristics. However, the effluent activity of this water varies seasonally and between similarly constructed reactor plants. For example, effluent activity is traditionally higher during the winter months than during the summer. In addition, effluent activity may be higher by a factor of 2 at B Reactor than at D Reactor for a month and then for no apparent reason, the situation may be reversed for the next month.

The detection of these seasonal or operational variables in the water plants so that the water treatment process can be adjusted to override the variables would provide better control and/or reduction of the reactor effluent activity discharged to the river.

III. DESCRIPTION OF PREFERRED SOLUTION

A. Sodium Silicate Addition Facilities

Facilities for the addition of sodium silicate to the treated water in the five reactor plants are relatively simple. Layout of a feed and storage system is shown on Figure 1. Sodium silicate would be added at the inlets of the 190 storage tanks in B and D, at 183 storage tanks in C, and at the inlets of the 183 clearwells in KE and KW. Water pressure in the process water systems at these locations is relatively low. The feed equipment would consist of positive displacement metering pumps to measure the concentrated sodium silicate, inline mixers in which the concentrated sodium silicate would be diluted with water to an approximate 10 percent solution, and centrifugal pumps to inject the dilute solution into the inlet piping or flumes to the storage tanks or clearwells. Downstream of the sodium silicate addition point, sulfuric acid would be added to adjust the pH of water to 6.6. The addition of sodium silicate at 20 ppm as SiO_2 requires an additional 12 ppm of 93 percent sulfuric acid feed for final pH adjustment. B, C, and D water plants have existing acid facilities to adjust the pH at the sodium silicate point of injection. At KE and KW water plants sulfuric acid feed lines would be extended from the 182 Buildings to the inlets of the 183 clearwells for pH adjustment of the water at that point.

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Sodium silicate storage capacity to be provided at each reactor plant is dependent upon the source of supply. For on-plant manufacture, storage capacity would be for five day's operation. For off-plant manufacture, storage capacity would be for fifteen day's operation. The sodium silicate storage tanks would be insulated and equipped with a recirculating system for heating and cooling as sodium silicate is sensitive to both heat and cold. All equipment, tanks, and piping would be of carbon steel. All piping and equipment handling concentrated sodium silicate would be provided with hose connections to water flush the systems when not in service. Truck unloading facilities would be provided for on-plant sodium silicate supply while rail unloading facilities would be provided for off-plant supply.

Sodium silicate feed rates based on 20 ppm as SiO_2 and storage capacity to be provided at the water plants for both sources of supply are shown below:

<u>Reactor</u>	<u>Process Water Flow, GPM</u>	<u>Sodium Silicate Feed, GPM</u>	<u>Storage Capacity Ga.</u>	
			<u>On-Plant Supply</u>	<u>Off-Plant Supply</u>
B	90,000	4.51	33,000	100,000
C	106,000	5.30	41,000	115,000
D	90,000	4.51	33,000	100,000
KE	220,000	10.97	80,000	240,000
KW	220,000	10.97	80,000	240,000

Estimated project costs of addition facilities at B, C, D, KE and KW reactor plants for on-plant supply of sodium silicate are \$425,000; for off-plant supply, \$830,000.

B. On-Plant Sodium Silicate Manufacture

A liquid process for manufacturing sodium silicate has recently been developed in private industry which can be economically adapted to on-plant manufacture and supply of sodium silicate for the addition of sodium silicate to the reactor process water. The new process differs from the conventional manufacturing process wherein soda ash and silica sand are fused into glass at high temperatures of about 2200 F, the glass is then cooled and ground, and finally dissolved into water under pressure to form a sodium silicate solution. Instead, the new process consists of reacting caustic soda, silica sand, and water under moderate temperatures and pressures to directly produce a sodium silicate solution. The reaction temperatures and pressures required for the new process can be easily supplied by steam produced at the reactor plants. Therefore, capital and operating costs for manufacturing and supplying sodium silicate could be markedly reduced since existing plant buildings and utilities can be used for the new process.

The process is a batch process, requiring 4 to 5 hours reaction time, and is not economically suited for installation in each reactor water plant. One manufacturing facility would be provided and located in

the 186-D Building to utilize the excess capacity of the D steam plant for an uninterruptible supply of steam. The reactor plants would then be supplied from D Area by trucks.

The process flow diagram for the proposed manufacturing facility is shown on Figure 2. The raw materials, silica sand and caustic soda, are delivered to 186-D by rail. The sand is then ground to 100 mesh size to accelerate the reaction. Feed batches for the reaction vessels are made up and mixed in advance. The feed slurry is then pumped from the makeup tanks into the reaction vessels. The feed in the reaction vessels is heated by steam to reactant pressures of approximately 125 psi. Estimated reaction time is 4 to 5 hours. Following completion of the reaction, the product is cooled and pumped to settling tanks where the excess sand is separated from the finished sodium silicate solution. The sodium silicate solution is then pumped to storage tanks while the excess sand is recycled back to the makeup tanks.

Approximately 300 tons per day of 28.7 percent SiO_2 sodium silicate is required for the five reactor plants. Four 5,000 gallon, nickel-plated, steam-jacketed, reaction vessels will be provided. Three batches will be manufactured in each reaction vessel per day. Two men per shift will operate the plant. Supervision will be provided by the Power shift supervisors. Supply to the reactor plants will be provided by two tank trucks with delivery on day shift only.

Estimated project cost of the on-plant sodium silicate manufacturing facility is \$735,000.

C. Water Treatment Instrumentation

Instrumentation to sample or monitor influent Columbia River water for control and/or reduction of reactor effluent is non-existent. The major problem is what to measure for correlation with effluent activity. There is a considerable time delay for a variation in the water treatment process to show up in reactor effluent activity results. With past production tests, where the water treatment process was slightly modified, as long as a month have been required before definite trends begin to appear in the reactor effluent activity. Monitoring precursor elements in the influent river water or after water treatment for comparison with the radionuclides in the effluent does not appear practical because of this time delay. Also, the concentrations of some of these precursors are in the parts per billion range. Instrumentation for the continuous measurement of one or more precursors would be very complicated as laboratory analytical methods for determining concentrations of some impurities in river water are complex and time consuming.

Research and development work is in progress with the use of zeta potentials to correlate optimum alum feed rates with reactor effluent activity. Zeta potentials (ZP) are measured of the river water colloids and the floc produced. To provide optimum flocculating conditions, the alum feed rate is adjusted until the ZP of the colloids reads zero.

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At this time, the electrical attraction between the aluminum floc and the incoming colloids and anions is the strongest for maximum adsorption of colloids and anions onto the floc. This method of control has been demonstrated in the water treatment pilot plant at 1706-KE with a reduction in radioarsenic and radiophosphorus achieved. Production tests for varying the alum feed are presently in progress at KE and KW to determine optimum alum feed rates. In addition, periodic zeta potential measurements are taken at all reactor water plants to develop statistical data for correlation with reactor effluent activity.

While zeta potential meters are commercially available and one could be placed in each water plant as an operational aid, this action should be deferred until a more comprehensive study of control and instrumentation for the water plants is made. It may be that periodic ZP measurements are adequate and that one meter will suffice for all water plants.

It is recommended that no funds be budgeted for instrumentation until the need, type, and availability of such instrumentation is resolved.

IV. JUSTIFICATION

Further reduction of the radionuclide burden to the Columbia River is consistent with the national radiation protection philosophy of reducing exposure risk to the public to a minimum. Whether the reduction of radionuclides discharged to the river which can be achieved by the addition of sodium silicate to reactor process water provides significant benefits to justify increased reactor operating costs is beyond the scope of this study. This decision rests with management who must consider other plant economics in their evaluation. It should be pointed out, though, that with the exception of high alum feed which was incorporated in the water treatment process in 1961, sodium silicate addition is the only pretreatment process that has been developed and tested, to date, which has achieved a significant reduction in radionuclides discharged to the river. The prospects of discovering new pretreatment processes capable of producing major reductions at modest costs do not appear imminent in the near future.

The addition of sodium silicate to the reactor process water is costly. Annual incremental plant water treatment chemical costs to utilize this process will approximate \$2,535,000 based on an addition rate of 20 ppm as SiO_2 and off-plant supply and delivery of sodium silicate. With on-plant sodium silicate manufacture and delivery, annual incremental chemical costs can be reduced to \$1,425,000. Estimated project costs to provide addition facilities at the five reactor plants for off-plant supply and delivery are \$830,000. Estimate project costs to provide addition facilities at the five reactor plants plus the on-plant manufacturing facility are \$1,160,000.

As shown above, on-plant sodium silicate production and supply achieves a significant reduction in chemical costs of the sodium silicate addition process. Pay-off of the manufacturing plant based on the difference in project costs between sodium silicate facilities for on-plant and off-plant supply and delivery is 0.3 years. Or, pay-off of the manufacturing plant based on actual project cost of the plant is 0.7 years. Either pay-off is economical.

Calculations of the increased chemical costs are presented below:

A. Chemical Costs

Basis:

20 ppm sodium silicate as SiO_2
 12 ppm sulfuric acid for pH adjustment
 Annual operation - 300 days/yr. at full flow

1. Off-Plant Supply and Delivery

Sodium silicate cost/100 lbs. containing 28.7 SiO_2	\$1.25
Sulfuric acid cost/lb.	\$0.0083
Annual sodium silicate costs	\$2,275,000
Annual additional sulfuric acid costs	260,000
Total	<u>\$2,535,000</u>

2. On-Plant Supply and Delivery

Sodium silicate cost/100 lbs. containing 28.7% SiO_2	\$0.64
Sulfuric acid cost/lb.	\$0.0083
Annual sodium silicate costs	\$1,165,000
Annual additional sulfuric acid costs	260,000
Total	<u>\$1,425,000</u>

B. On-Plant Sodium Silicate Manufacturing Costs

Basis:

Caustic soda cost	\$60/ton
Silica sand cost	\$10/ton
Process steam cost	\$1/1,000 lbs.
Water cost	\$35/10 ⁶ gallons
Electrical cost	\$21.40/KW yr.
Two operators/shift, 3 shifts	\$352/day
Two truck drivers, day shift delivery	\$88/day

Maintenance	\$50,000/yr.
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Manufacturing cost/100 lb. sodium silicate with 28.7% as SiO_2	\$0.64
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Percentages of On-Plant Sodium Silicate Manufacturing Costs

NaOH	55.7
Silica sand	26.6

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Process steam	4.0
Water and electrical power	0.1
Plant operation	7.9
Plant maintenance	3.7
Sodium silicate delivery	2.0
Total	100.0

V. PROJECT SCHEDULE

Sufficient information is available so that sodium silicate addition can be incorporated into the reactor water treatment process without delay. With respect to on-plant sodium silicate manufacturing, pilot plant testing is necessary to determine optimum process conditions to design and operate the plant under. On this basis, the following project schedule is presented:

<u>Function</u>	<u>Start</u>	<u>Complete</u>
Development-pilot plant test	October, 1966	March, 1967
Design	April, 1967	April, 1968
Procurement	December, 1967	July, 1968
Construction	April, 1968	April, 1969

VI. COST ESTIMATE AND OBLIGATION AND EXPENDITURE FORECASTING

The project cost of sodium silicate addition facilities in B, C, D, KE, and KW reactor plants and an on-plant sodium silicate manufacturing facility in 186-D Building is \$1,130,000. See Attachment D for breakdown of estimate. In addition to the above estimate, project cost estimates were obtained for various parts of the sodium silicate system for economic analyses. These cost estimates are also included as attachments.

The obligation and expenditure patterns for execution of the project work are shown below:

	<u>Fiscal Year Forecast</u>			
	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>Total</u>
<u>Obligation</u>				
AE Services	\$169,000			
Construction		\$800,000		
<u>Expenditures</u>				
AE Services	\$ 20,000	\$110,000	\$ 39,000	\$ 169,000
Construction		\$300,000	\$691,000	\$ 991,000
Total Expenditure	\$ 20,000	\$410,000	\$730,000	\$1,160,000

VII. METHOD OF PERFORMANCE

Design will be performed by the on-site Architect-Engineer. Construction of the sodium silicate feed facilities will be performed by the on-site CPFF Construction Service Contractor and its subcontractors. Construction of the sodium silicate manufacturing plant will be performed by a

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fixed-price contractor awarded on competitive bidding. Project management will be performed by AEC.

VIII. CLASSIFICATION OF THE PROJECT

The scope of the work involves installation of equipment but because of the magnitude of the estimate the project is classified Capital Plant.

IX. PROCUREMENT PLANNING

All equipment for the sodium silicate addition facilities and the reaction vessels for the manufacturing facility will be procured by the CPFF Construction Contractor on competitive bids. The remainder of equipment for the manufacturing facility will be procured by the lump sum contractor.

X. CONTINUITY OF OPERATION

Construction of the sodium silicate feed and manufacturing facilities will not interfere with reactor operation. Tie-in of the feed piping to the 190 tanks and clearwells will be scheduled during normal reactor refueling outages.

XI. RELATED WORK

Reactor work which must be completed prior to startup of the sodium silicate addition facilities is to develop procedures and methods for counteracting or overcoming film buildup in the reactor tubes and increased rear face exposure which appears to be attendant with sodium silicate addition. Film buildup causes increases in Panellit pressures which are a fundamental part of the reactor safety systems. Present method for overcoming film buildup is periodic purges of diatomaceous earth. Whether this method will be satisfactory will have to be determined.

With respect to the increased rear face exposure, the isotope which is concentrating on the rear face is lanthanum-140. Investigations are presently underway to determine from where it originates.

XII. OTHER DISCUSSION

Permission is granted to extract information from this study as may be required for preparation of the budget document.

XIII. ALTERNATE SOLUTIONS

There are no alternate pretreatment processes capable of substantially reducing reactor effluent activity developed at this time. Preliminary investigations have been made of a post-treatment process whereby the reactor effluent water would be diverted through canals by gravity flow to the natural sinks on the north and south side of Gable Mountain for disposal through soil percolation. Reduction factors of 10 to 100 have been estimated for this method. Development work on this process was discontinued per AEC direction because they are not interested in post-treatment processes at this time.

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An alternate to on-plant sodium silicate manufacturing is to interest a chemical company to locate a sodium silicate manufacturing in the Tri-City vicinity or in the 100 Areas. Companies utilizing the conventional manufacturing process might not be too interested because of the substantial capital investment required to erect a plant. However, they might be interested in providing a partial manufacturing facility, with dissolvers, where ground glass frit would be dissolved producing a sodium silicate solution. The ground frit would then be supplied from one of their established manufacturing plants.

In addition, companies utilizing the liquid manufacturing process would be interested because of considerably smaller capital investment for such a manufacturing plant. Because of the nature of the study, no contacts with chemical companies were made at this time.

XIV. ATTACHMENTS

- A. Figure 1 - Sodium Silicate Addition Facility
- B. Figure 2 - Sodium Silicate Manufacturing Facility
- C. Project Cost Estimates
 - 1. Sodium Silicate Addition and On-Plant Manufacturing Facilities
 - 2. Sodium Silicate Addition Facilities for On-Plant Supply
 - 3. Sodium Silicate Addition Facilities for Off-Plant Supply
 - 4. Sodium Silicate Manufacturing Facility
- D. Procurement Plan
- E. Project Data Sheet

XV. ACKNOWLEDGEMENTS

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E. L. Etheridge
Engineer, Plant Design
Facilities Engineering

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FIGURE-1. SODIUM SILICATE ADDITION FACILITY

FIGURE 2
SODIUM SILICATE ADDITION AND MANUFACTURING FACILITIES

CRITICAL PATH CHART

- A. Preliminary Engineering & Testing
1. Budget Study
 2. Design & Construction of Pilot Plant
 3. Pilot Plant Testing
- B. Project Proposal Preparation
4. Engineering Study
 5. Project Proposal and Authorization
 6. Design Criteria

- C. Project
7. Title I Design
 8. Title II Design
 9. Procurement
 10. Construction
 - a. CPFF part (addition facilities)
 - b. Lump sum part (manufacturing plant)

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BUDGET STUDY

DOUGLAS UNITED NUCLEAR, INC.

SODIUM SILICATE ADDITION
AND MANUFACTURING FACILITY

	<u>DIRECT ESTIMATED COST</u>	<u>PRO-RATED OVERHEAD</u>	<u>TOTAL</u>
AE Services			
Title I Design	\$ 15,000		
Title II Design	103,000		
Title III Services	38,000		
Technical Guidance	-		
Auxiliary Services	<u>13,000</u>		
Total AE Service	169,000		\$169,000
Construction/Installation			
Improvements to Land			
Buildings			
Other Structures			
Special Facilities	678,500	121,500	800,000
Utilities			
Standard Equipment			
Removal Cost Less Salvage			
Total Construction	<u>678,500</u>	<u>121,500</u>	<u>800,000</u>
Contingency			<u>191,000</u>
Total Project Cost			\$1,160,000
Equipment Procurement Cost			
Storage Tanks	\$ 95,000		
Day Tanks	10,000		
Pumps	35,000		
Dozer	20,000		
Tank Trucks	90,000		
Vessels	95,000		
Handling Equipment	<u>50,000</u>		
	\$395,000		

Estimate by Vitro Engineering Co.

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BUDGET STUDY

DOUGLAS UNITED NUCLEAR, INC.

SODIUM SILICATE ADDITION FACILITIES
100-B, C, D, KE and KW AREAS
ON-PLANT SUPPLY WITH TRUCK DELIVERY

	<u>DIRECT ESTIMATED COST</u>	<u>PRO-RATED OVERHEAD</u>	<u>TOTAL</u>
AE Services			
Title I Design	\$ 5,000		
Title II Design	53,000		
Title III Services	20,000		
Technical Guidance	-		
Auxiliary Services	<u>8,000</u>		
Total AE Service	86,000		\$ 86,000
Construction/Installation			
Improvements to Land			
Buildings			
Other Structures			
Special Facilities	241,500	28,500	270,000
Utilities			
Standard Equipment			
Removal Cost Less Salvage			
Total Construction	<u>241,500</u>	<u>28,500</u>	<u>270,000</u>
Contingency			<u>69,000</u>
Total Project Cost			\$425,000
Equipment Procurement Cost			
Storage Tanks	\$ 95,000		
Day Tanks	10,000		
Pumps	<u>25,000</u>		
Total Equipment Procurement Cost	\$130,000		

Estimate by Vitro Engineering Co.

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February 1, 1966

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BUDGET STUDY

DOUGLAS UNITED NUCLEAR, INC.

SODIUM SILICATE ADDITION FACILITIES
100-B, C, D, KE and KW AREAS
OFF-PLANT SUPPLY WITH RAIL DELIVERY

	<u>DIRECT ESTIMATED COST</u>	<u>PRO-RATED OVERHEAD</u>	<u>TOTAL</u>
AE Services			
Title I Design	\$ 5,000		
Title II Design	53,000		
Title III Services	20,000		
Technical Guidance	-		
Auxiliary Services	<u>8,000</u>		
Total AE Service	86,000		\$ 86,000
Construction/Installation			
Improvements to Land			
Buildings			
Other Structures			
Special Facilities	547,000	58,000	605,000
Utilities			
Standard Equipment			
Removal Cost Less Salvage			
Total Construction	<u>547,000</u>	<u>58,000</u>	<u>605,000</u>
Contingency			<u>139,000</u>
Total Project Cost			\$830,000
Equipment Procurement Cost			
Storage Tanks	\$280,000		
Day Tanks	10,000		
Pumps	<u>25,000</u>		
	\$315,000		

Estimate by Vitro Engineering Co.

February 1, 1966

BUDGET STUDY

DOUGLAS UNITED NUCLEAR, INC.

SODIUM SILICATE MANUFACTURING PLANT
186-D BUILDING

	<u>DIRECT ESTIMATED COST</u>	<u>PRO-RATED OVERHEAD</u>	<u>TOTAL</u>
AE Services			
Title I Design	\$ 10,000		
Title II Design	50,000		
Title III Services	18,000		
Technical Guidance	-		
Auxiliary Services	<u>5,000</u>		
Total AE Service	83,000		\$ 83,000
Construction/Installation			
Improvements to Land			
Buildings			
Other Structures			
Special Facilities	437,000	93,000	530,000
Utilities			
Standard Equipment			
Removal Cost Less Salvage			
Total Construction	<u>437,000</u>	<u>93,000</u>	<u>530,000</u>
Contingency			<u>122,000</u>
Total Project Cost			\$735,000
Equipment Procurement Cost			
Dozer D4	\$ 20,000		
Tank Trucks	90,000		
Vessels	95,000		
Handling Equipment	50,000		
Pumps	<u>10,000</u>		
Total Equipment Procurement Cost	<u>\$265,000</u>		

Estimate by Vitro Engineering Co.

February 1, 1966

PRE - PROCUREMENT PLANNING				DATE	
				Feb. 7, 1966	
SUBJECT					
Budget Study - Sodium Silicate Addition Facilities, 100-B, C, D, KE and KW Areas					
DEPT. DUN		SECTION FES		SUBSECTION Project Engineering	
SPECIFICATION AUTHOR A.E.		BUILDING Federal Bldg.		PHONE	ANTICIPATED ISSUE DATE
REQUISITION AUTHOR C.P.F.F.		BUILDING 1206		PHONE	ANTICIPATED ISSUE DATE
1. BRIEF DESCRIPTION OF PROCUREMENT ITEM (INCLUDE SUMMARY OF DEVELOPMENT HISTORY, ANY MARKET SURVEYS, ETC.):					
Tanks, pumps and handling equipment for producing sodium silicate.					
2. END USE (INCLUDING BUILDING, PROJECT REFERENCE, ETC.):					
Will provide plant for manufacture at one area and distribution by truck to storage and use points at 105-B, C, D, KE & KW Areas.					
3. ESTIMATE OF PROBABLE COST (ORDER OF MAGNITUDE): \$395,000					
4. DO YOU FORESEE A REASON FOR NOT PURSUING A FIXED-PRICE ORDER (CONTRACT): No EXPLAIN:					
5. DESCRIBE ANY SPECIAL FEATURES OF THE PROCUREMENT, SUCH AS REQUIRED DESIGN, SINGLE OR RESTRICTED SOURCES, SPECIAL TESTS, SCHEDULES TO BE MET, ETC. (ATTACH ADDITIONAL SHEETS AS NEEDED):					
In-plant tests covering about a period of a year are scheduled prior to firming design and completion of procurement specifications.					
6. CATEGORY <u>B</u> (INDICATE "A" FOR COMPLEX PROCUREMENT REPRESENTING POTENTIAL PROBLEMS, OR "B" WHEN NORMAL PROCUREMENT ON COMPETITIVE BIDS IS ANTICIPATED WITHOUT SUBSTANTIAL DELAY OR DIFFICULTY):					

U.S. ATOMIC ENERGY COMMISSION

SCHEDULE 44

RICHLAND

CONSTRUCTION PROJECT DATA SHEET

OPERATIONS OFFICE

SUBPROGRAM

1. TITLE AND LOCATION OF PROJECT: Process Water Treatment For Effluent Activity Control
DUN Operated Reactors, Richland, Washington

2. PROJECT NO.

3. Date AE Initiated:
4th Quarter, FY 1967

5. Previous Cost Estimate
None

6. Current Cost Estimate
Date 1/31/66 \$1,160,000

3a. Date Physical Construction Starts
4th Quarter, FY, 1968

4. Date Construction Ends:
4th Quarter, FY 1969

7. Obligation and Cost Schedule

<u>Fiscal Year</u>	<u>Obligations</u>	<u>Costs</u>
1967	\$169,000	\$20,000
1968	\$800,000	\$410,000
1969	0	\$730,000

8. Brief Physical Description of Project

Feed facilities, consisting of positive displacement pumps, inline mixers and centrifugal pumps, are to be installed in the 190 Buildings of B, C, D, KE and KW reactor plants to permit adding sodium silicate to the reactor process water for reducing the reactor effluent activity. Sodium silicate storage tanks with capacity equivalent to 5 days supply are also provided at the feed facilities. In addition, sodium silicate manufacturing facilities, consisting of makeup tanks, reaction vessels, settling tanks and storage tanks and associated pipe and pumping equipment, are to be installed in 186-D Building for the production and supply of sodium silicate to the feed facilities in the reactor plants.

9. Justification of Need

Justification of this project is based upon the benefits gained of further reducing the radionuclide burden to the Columbia River which is discharged in the reactor effluent.

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DUN-630

U.S. ATOMIC ENERGY COMMISSION

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2. PROJECT NO.

10. Details of Cost Estimate

<u>Item</u>	<u>Estimated Cost</u>
a. Engineering, design, and inspection at approximately 21% of construction, Item C.	\$169,000
b. Construction Cost:	
1. Special Facilities	\$800,000
c. Contingency at approximately 20% of above costs	\$191,000
TOTAL PROJECT COST	\$1,160,000

11. Major Contractor and Intended Type of Contract

Design will be performed by the on-site CPFF Architect-Engineer. Construction of the sodium silicate addition facilities will be performed by the on-site CPFF Construction Contractor and his subcontractors. Construction of the on-plant sodium silicate manufacturing facility will be performed by a fixed price contractor determined by competitive bidding.

12. Incorporation of Fallout Shelters in Future Federal Buildings

Not applicable. The proposed scope of work does not include construction of new buildings.

DATE

FILMED

10/21/94

END