THE FUTURE OF SALINE WATER CONVERSION, 1963

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Before the future of saline water desalting processes is discussed, it will be well to discuss the basis for Federal action in the future and to review the basis for work carried out to date. Public Law 85-883, dated September 2, 1958, provides for the construction, operation, and maintenance of not less than five demonstration plants for the production (from sea water or brackish water) of water suitable for agricultural, industrial, municipal, and other beneficial comsumptive uses. This Act specifies that such plants shall demonstrate the reliability, engineering, operating, and economic potentials of sea and brackish water conversion by five of the most promising processes, to be selected by the Secretary of the Interior from among the most promising of the presently known processes.

In order to achieve the objectives of Public Law 85-883, five processes and sites were selected for the first-generation plants. The processes, sites, construction contractors, operation contractors, and the dates when four of these various activities occurred are given in Table 1. The 1-million gpd LTV falling film distillation plant at Freeport, Texas, has been operating since June 1961, providing data for the design and evaluation of a large-scale, second-generation plant. Similarly, both the 1-million gpd multistage flash distillation plant at San Diego, California, and the 250,000 gpd electrodialysis plant at Webster, South Dakota, have been operating since March 1962.

In April 1962 construction was begun on the forced circulation vapor compression distillation plant at Roswell, New Mexico.

Specifications were prepared and bids received for a fifth plant in July 1962, to demonstrate the freeze process in a 250,000 gpd plant at Wrightsville Beach, North Carolina. When considering the award of the construction contract, however, it was realized that, in the light of new evidence, the size selected was too small to demonstrate the process on a large and practical scale, and therefore, the bids were rejected. The process is now relegated to further pilot plant work.

Public Law 87-295, dated September 22, 1961, extends and modifies the Demonstration Plants Act of 1958 in several respects. It provides that the Secretary shall conduct engineering research

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TABLE 1. STATUS OF DEMONSTRATION PLANTS PROGRAM, OCTOBER 1962

Plant No.	1	2	3	4
Process selected	Distillation, falling film, 12-effect.	Distillation, flash 36-stage.	Electrodialysis, 4-stage.	Distillation, vapor compression.
Capacity, gpd	1,000,000	1,000,000	250,000	1,000,000.
Date process selected	Mar. 2, 1959	May 14, 1959	June 22, 1959	Dec. 2, 1959.
Scale prevention tech	pH control	Hagevap (3 ppm)	Low current density	Ion exchange or slurry.
Top temperature, °F	250	200	50	232.
Power consumed, KWH/M gal	8.11	3.18	6.4 (10.2)	55.9.
Fuel, Btu/M gal	0	0.95×10^6	0	3,120.
Steam, Btu/M gal	0.846×10^6	0	0	0.
Concentration factor	3.0	2.0	2.2	4.0.
Location of plant	Freeport, Tex	San Diego, Calif	Webster, S. Dak	Roswell, N. Mex.
Date site selected	July 14, 1959	Oct. 6, 1959	Feb. 3, 1960	Feb. 3, 1960.
Date of groundbreaking	Aug. 30, 1959	Dec. 19, 1960	May 19, 1961	July 10, 1962.
Date of dedication	June 21, 1961	Mar. 10, 1962	Oct. 20, 1961	
Architect-engineer firm	W. L. Badger Associates.	Fluor Corp	Bureau Reclamation	Catalytic Construction Co.
Amount of contract	$116,950	$108,283	$49,900	$96,700.
Date of specs issue	Apr. 1, 1960	Sept. 1, 1960	Aug. 1, 1960	Oct. 12, 1961.
Bid opening date	May 24, 1960	Oct. 18, 1960	Oct. 3, 1960	Dec. 12, 1961.
Construction firm	Chicago Bridge & Iron.	Westinghouse Electric.	Asahi Chem. Ind. Co., Ltd.	Chicago Bridge & Iron.
Amount of contract	$1,255,712	$1,663,246	$485,900	$1,794,000.
Date of contract award	June 8, 1960	Nov. 5, 1960	Nov. 11, 1960	Apr. 6, 1962.
Construction period	365 days	365 days	300 days	365 days.
Operation and Management firm	Stearns-Roger Manufacturing Co.	Burns & Roe, Inc	Mason-Rust	
Amount of annual contract	$241,249	$183,189	$113,729	
Date of contract award	Apr. 28, 1961	Jan. 3, 1962	Nov. 30, 1961	
Date operation started	May 31, 1961	Mar. 5, 1962	Mar. 8, 1962	

and technical development work, by laboratory and pilot-plant testing, to develop processes and plant design to the point where they can be demonstrated on a large and practical scale. He shall recommend to the Congress for construction and operation, or for participation in the construction and operation, of a demonstration plant for any process which he determines shows great promise of accomplishing the purposes of the Act.

In the original law it was proposed to build first-generation demonstration plants of a capacity sufficient to develop to the highest degree the potentials of operating reliability and economics. The results of research work would be evaluated in these plants and the data obtained would be developed for use in the design, construction, and operation of second-generation plants which would demonstrate processes on a large and practical scale.

The development of any low-cost process will require operation without formation of scale in the equipment. In order to achieve low costs, it is also necessary to develop a high volume of water output per unit dollar value of equipment used. So far, only the distillation and the electrodialysis processes have been demonstrated to be capable of these objectives over an extended period of time.

A measure of success has been achieved in this respect for the distillation process by use of the scale control method known as "pH control" which has permitted increased output for 40% from the San Diego plant with only slightly higher daily costs while operating at somewhat higher temperature than originally planned. The electrodialysis process is subject to scale formation on the membranes due to the pressure of insoluble ingredients in the waters being processed. Through the use of reverse polarity, it has been possible to operate at higher current densities and obtain results desired in three stages formerly not attainable in four stages. There are studies under way in process development which will, if successful, permit markedly greater production from these two processes with lower dollar value of the equipment. The results of operation of the first three plants for a short period of time are published in Office of Technical Services Report No. PB which indicates the costs for plants and water produced from the present plants and that expected from larger plants. Figures 1 and 2 show the expected costs from the three plants as the size is increased. The solid portion of the lines indicate the size of plants for which detailed costs have been studied. The most favorable distillation process at the moment is the flash distillation process in use at the San Diego plant, the flowsheet for which is shown in Figure 3.

BECHTEL STUDY PLANT COSTS

Figure 1

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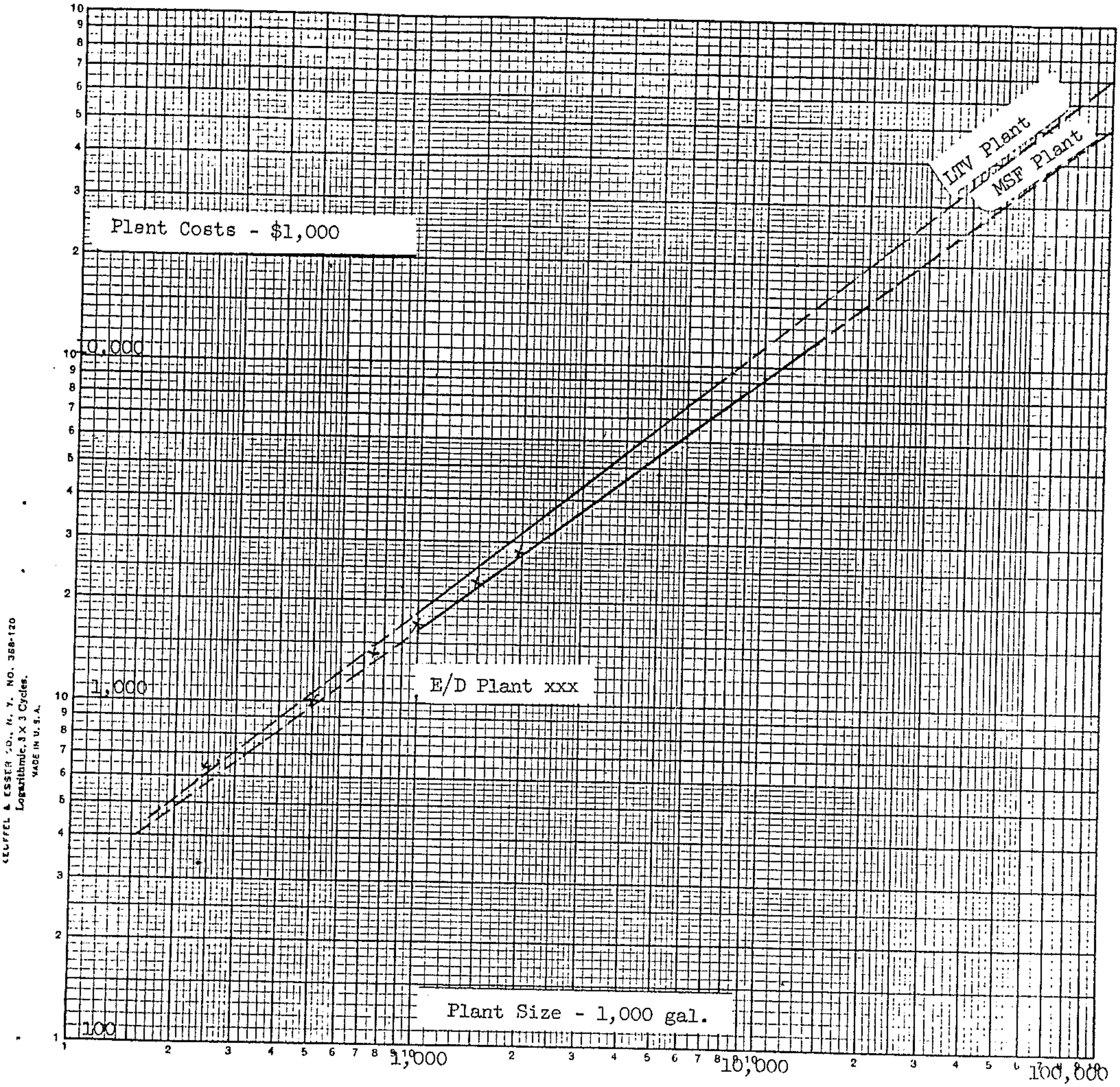

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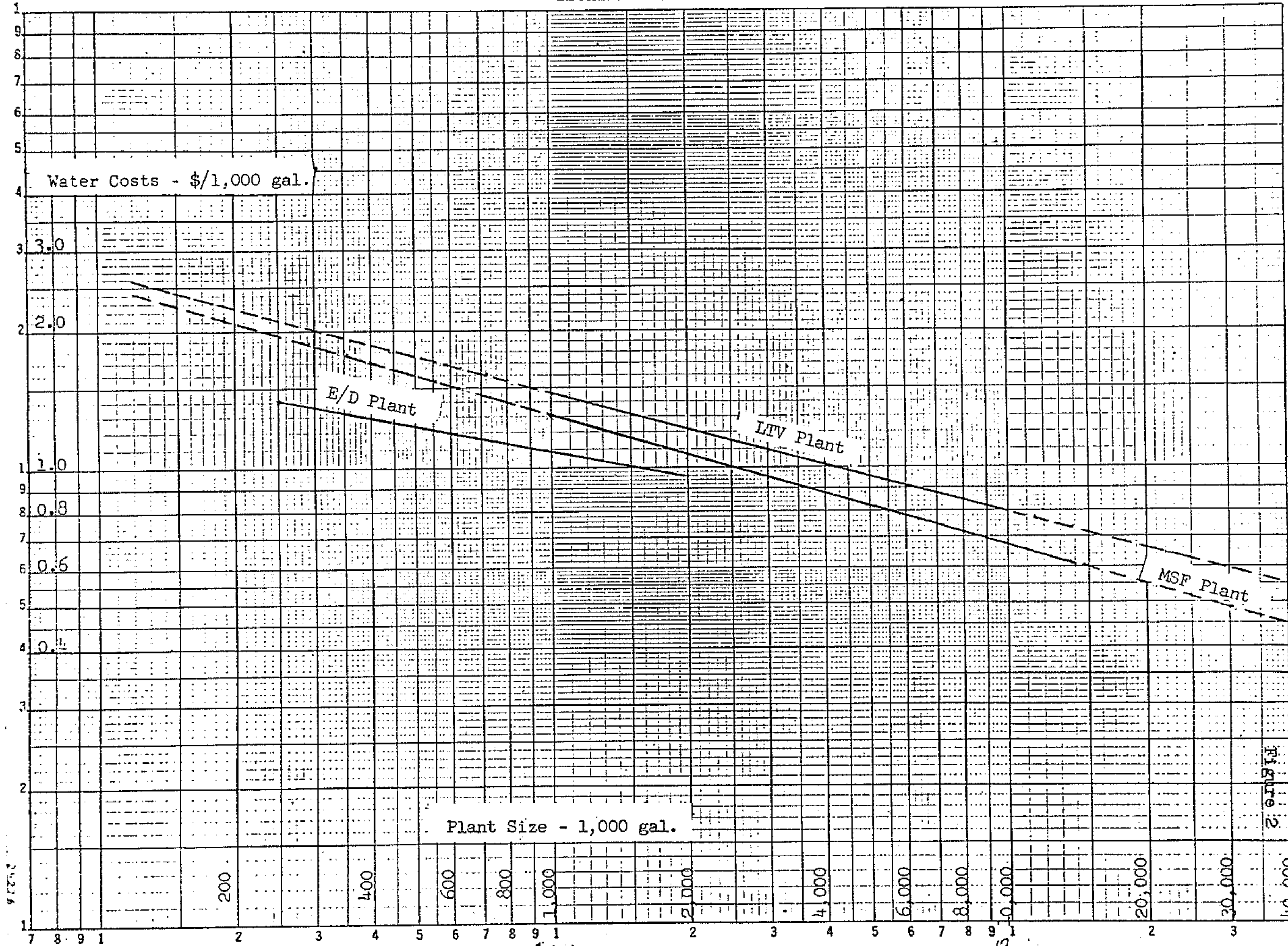
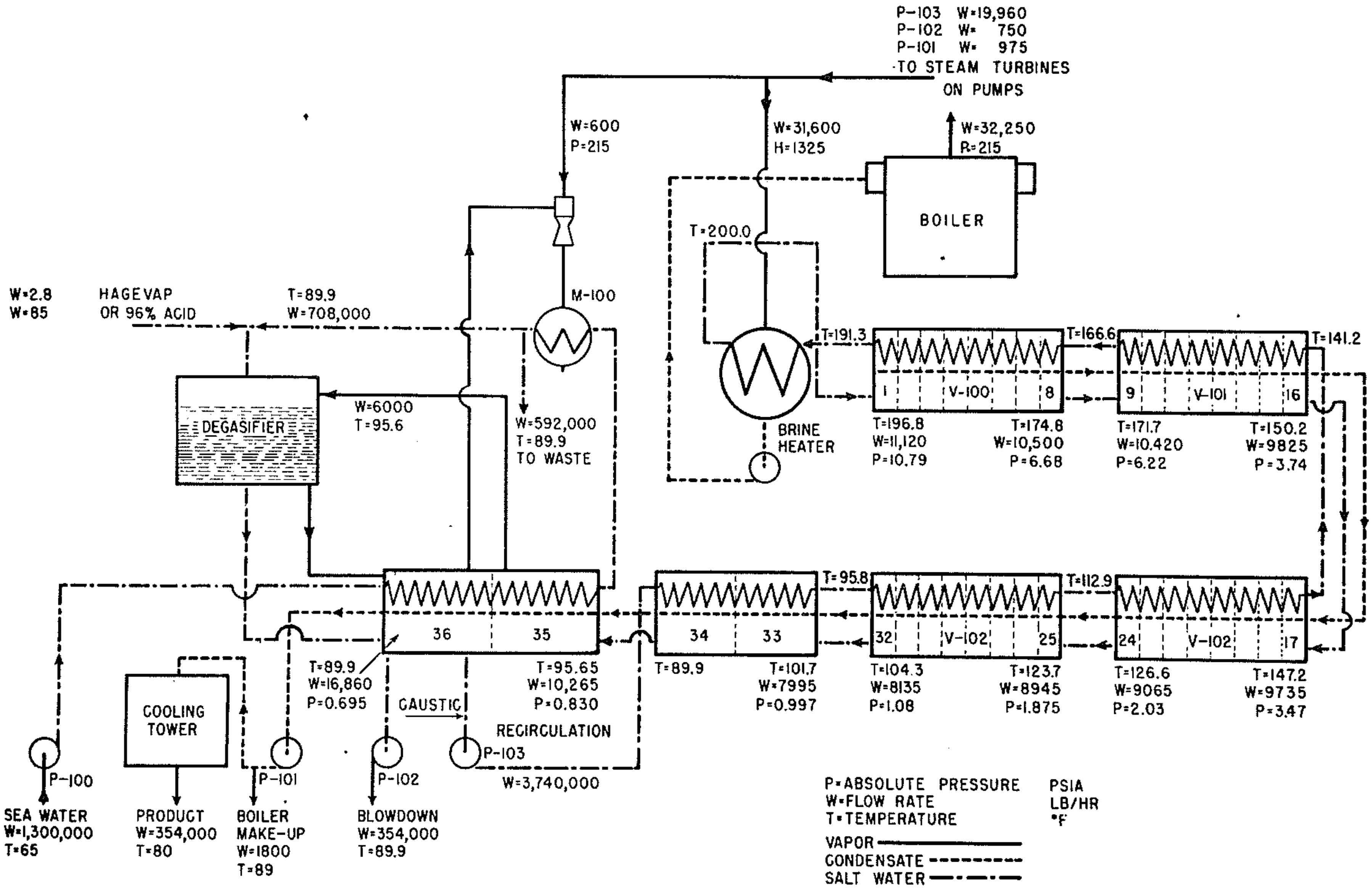
BECHTEL STUDY WATER COSTS





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WASHINGTON, D.C.

FIGURE 3. FLOW SHEET FOR FLASH DISTILLATION PLANT
FOR 200°F OPERATION
36 STAGE

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A considerable amount of work is under way in the Research and Process Development Divisions and the attainment of lower-cost water will depend upon a continued effort in this direction. The freezing and hydrate processes are developing to the pre-demonstration plant stage. These are both thermal processes, and thermal economy is dependent upon heat exchange between incoming and outgoing streams, much the same as in the distillation process. Osmosis of one sort or another may be a possibility--much is yet to be discovered before a low-cost product water is obtained. Modifications to the electrodialysis process offer possibilities for cost reduction. The objective of low-cost water will probably be achieved only by the whittling away of costs from the present values by continued effort to pare off a little at a time.

As mentioned above, water costs from normalized plants have been developed for large-scale plants. These studies provided preliminary designs and detailed cost estimates. They show that energy costs and investment costs become more important as size of plant is increased. By associating the desalting plant with a thermal-power generating plant, it is possible to decrease both the energy and investment cost appreciably. For large plants, one-million gallons of water (3 acre feet) can be produced for each 3 MWE of generating capacity. High quality water from such a plant is expected to cost $0.30 to $0.35 per 1000 gallons ($93 to $108 per acre-foot) in the 50-to 1000-million gallon per day size. This would be 5,000 to 10,000 acre-feet per year size associated with 150 to 300 MWE power plants.

The population increase for the next five decades for New Mexico and the Southwest will be tremendous, probably tripling the population in this time. The present irrigated lands will be converted to municipal subdivisions and the existing water supply used for civilian use. The water and power demand and supply for New Mexico must be coordinated with that of the Southwest. A comprehensive plant for augmenting the existing supplies and developing and financing additional water and related power resources for the future benefit of this area must be organized.

Additional water supplies to alleviate present water deficiencies and to meet the demands resulting from Southwest population growth would be obtained by conservation of existing supplies, desalination of saline water and import from areas with future water supplies.

The electric power demands for projected water pumping and commercial uses are of such magnitude that it will require a proportion of power produced by sources other than the hydroelectric capability. The promotion of the greatest economics of both water and power users will require that the power loads should be integrated and each source used to serve the portion of the load to which it is best suited. This principle will result in hydroelèctric power plant capacity being devoted to peaking capacity, and the thermal power devoted to base load use. The thermal plants would be used for water pumping and water desalting plants.