Redirect - Rebuttal Testimony of

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Supporting Information for Staff Testimony on Cooling Towers

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I. Introduction

This document provides information used to support the staff's position in the Final Environmental Statement of September 1972 on an alternate closed-cycle cooling system at Indian Point Unit No. 2, which is in response to the cross examination of the staff by the applicant on December 7, 1972 (follows Tr. 69281), and by the intervenor on January 19, 1973 (Tr. 9352).

Specifically, this testimony addresses the following areas:

1. Further discussion on construction schedules for implementing a closed-cycle cooling system at Indian Point, including the time an initial decision is made, request for bids, awarding of contracts, construction time, and pre-operational testing time and outage. Information furnished by individual applicants on schedules at Davis Besse, Vermont Yankee, and Palisades is presented and analyzed.
2. Additional information on costs, including capital and operating costs, expended based on experience at the nuclear power plants mentioned above, as well as other plants, is presented as a point of reference upon which the staff has noted large differences in cost figures which are difficult to compare with those presented by the applicant.

II. Schedule Details of Construction of a Closed-Cycle Cooling System at Indian Point

In regard to the anticipated schedule for design and construction of an alternate closed-cycle system for Indian Point Unit No. 2, the staff on

page vii of the Summary and Conclusions in its Final Environmental Statement stated that at Indian Point No. 2, operation with the once-through cooling system will be permitted until January 1, 1978, and thereafter, a closed-cycle cooling system shall be required. The staff (Tr. 6939) stated that this date would allow for design and construction of the selected system within a period of about three and one half years.

The staff (follows Tr. 6939) points out that this period includes the design, issuance of specifications, receipts of bids, awarding of contracts, construction and cross-over into the plant of an alternative cooling system. To further substantiate that such a schedule is a reasonable one for the applicant to follow, dates and elapsed time for design, issuance of specifications, receipts of bids, awarding of contracts, construction, and system cross-over to the plant are shown in Table I for three power reactors - Davis Besse (natural draft cooling towers), Vermont Yankee and Palisades (mechanical-draft cooling towers). The cooling tower schedule from the time an initial decision was made to build towers to the completion of preoperational testing of the installed towers ranges from a projected period of about 3 years, 8 months for the Davis Besse natural-draft towers down to 3 years, 1 month for the Vermont Yankee mechanical-draft towers to 2 years, 8 months for the Palisades mechanical-draft towers. The work schedule for the Palisades towers involved two ten-hour shifts for six days per week to complete the work done including the backfitting.

Table 1

Cooling Tower Time

	Davis Besse		Vermont Yankee		Palisades	
Power	906 MWe		524 MWe		700 MWe	
Contractor Tower Type	Research Cottrell Natural Draft (490 ft. high 415 ft. dia. at base)		Fluor-Ebasco Mechanical Draft		Bechtel Mechanical Draft	
	Dates	Time	Dates	Time	Dates	Time
Initial Decision	7/30/70	0	10/12/67	0	3/12/71	0
Specs sent out for bid	1/27/71	∿6 mo.	9/4/68	∿11 mo.	4/13/71	∿1 mo.
Completed Bid Evaluation	4/23/71	∿3 mo.	1/3/69	∿4 mo.	6/29/71	∿2.5 mo.
Contract Awarded	4/27/71	∿4 days	2/14/69	∿1.2 mo.	7/29/71	∿1 mo.
Construction Started	6/1/71	∿1.2 mo.	9/69	∿7.5 mo.	5/72	∿10 mo.
Construction Completed	7/73	∿2 yr. 1 mo.	11/20/70	∿1 yr., 2 mo.	1/15/73	∿8 mo.
Preoperational Testing Completed	3/74	8 mo.			11/30/73	∿10.5 mo. includes 3 mo. outage for cross over
Total Time Elapsed		∿3 yr., 8 mo.		∿3 yr., 1 mo.		∿2 yr., 8 mo.

It has been reported to the staff that for natural-draft cooling towers, it would require about 3 months to a year for design studies, 6 weeks to 2 months for bidding, up to 3 months for acceptance of a contract, 2 to 3 years for actual construction, and 1 week for testing. Thus, a minimum time required would be 2 years, 9 months and the maximum time, 4 years, 9 months.

The staff (Tr. 6952) also discusses the requirement that a study to be prepared by the applicant on various alternative closed-cycle cooling systems, their cost and their impact on the environment, shall be submitted to the Atomic Energy Commission by July 1, 1973 (FES, Summary and Conclusions, item 7b). The purpose is to determine a preferred system. Thus, there will be a time period of four and one-half years starting on July 1, 1973, until January 1, 1978, in which one can conceive that based on experience at other plants, the applicant should have sufficient time to conduct meterological, design and siting studies in addition to awarding a contract, completing construction, and crossing over the tower into the plant to meet the January 1, 1978 date. Therefore, the staff believes that a reasonable schedule has been recommended.

III. Capital and Operating Costs of an Alternate Closed Cycle System

Costs estimates for alternative condenser cooling systems vary widely depending on cooling element, pumps, piping, condenser sign, back-fitting, and many other factors. The staff has made a brief outline

Table II

Capital Costs for Cooling Towers [a]

Plant	Total MWt	Tower Type	Capital Costs (millions)
Hatch	5074	Mech. Draft	$4.05
Palisades	2200	Mech. Draft	20
Trojan	3570	Nat. Draft	16.2
Davis Besse	2722	Nat. Draft	9
Vermont Yankee	1593	Mech. Draft	6
Arkansas Nuclear One, No. 2	2900	Nat. Draft	17 (tower basin intake structur pumps, piping, and condensers)
Beaver Valley	2774	Nat. Draft	23 (installed)
Three Mile Island Unit 1	2535	Nat. Draft	8.15
Unit 2	2772	Nat. Draft	9.26
Rancho Seco	2400	Nat. Draft	7

(a) Nuclear Industry, 19:9, September (1972), pp. 11-13.

and many other factors. The staff has made a brief outline in Table II of the capital costs of such systems for several representative nuclear power plants. According to an article, "Cooling Towers", in the December 1972 issue of Power Engineering, (76:12, p. 33) costs range as follows:

Once-through	$3-5 million
Wet Towers	$8-13 million
Dry Towers	$25 million

A wet tower would add about 1% or less to the utility customer's bill.

This information was based on a Battelle Pacific Northwest Laboratories report (SA-3581) on typical plant cooling systems costs for 1000 MWe light water reactors (at 32% thermal efficiency) based on 1971 costs projected to 1975 operation.

From the September 1972 issue of Nuclear Industry, average costs may run in the range of $8 to $10 per kilowatt for mechanical-draft towers and $12-15 per kilowatt for natural-draft towers.

In regard to costs related to constructing mechanical draft cooling towers at the Palisades Plant personnel of the licensee supplied the following information:

Engineering Categories	Cost*
1. Process Mechanical Equipment	$4,365,000
2. Installation of Electrical Equipment	1,228,000
3. Civil and Structural Engineering	3,860,000
4. Process Piping and Instrumentation	180,000
5. Yard work, Miscellaneous	270,000
	$9,903,000

*Costs include labor, materials, and subcontracts

Additional costs include:

Manual work	$1,700,000
Engineering and Office Work	1,100,000
Contingency	1,600,000
Escalation	600,000
Total Engineering Costs	$15,000,000
Direct Costs, Taxes, Insurance	1,000,000
Overhead Costs	400,000
Total Capital Costs	∿ $16,500,000

Operating costs run about $300,000 per year including chemical treatment of blowdown. The plant is derated by 23 MWe. According to the September 1972 issue of Nuclear Industry, the capacity loss will amount to $1.5 million per year.

The capital and operating costs vary over a wide range depending on site conditions, stage of plant construction, tower type, size, and location relative to the condensers, piping, pumps, backfitting besides maintenance, replacement power, purchase power, loss of capability and other considerations.

We also note the sizeable difference of the base cost of $31.27 million for Unit No. 2 reported by the applicant on Tr. 7745 and $54.34 million reported for Unit No. 2 in Supplement No. 3 to the Environmental Report due primarily to the piping costs because of the location of the tower relative to the condensers. The total (with contingency and escalation) costs of $95.86 million*reported by the applicant in Supplement No. 3 are also quite

* Costs include excavation, intake structure modification, booster pumps and house, installed cooling tower, piping and electrical costs.

different from the $119.7 million for the two tower system reported in Table B of its testimony of October 30, 1972 because of calculations based on January 1978 rather than the 1975 date for tower installation.

Until a specific type, engineered design, and location of a closed-cycle system are recommended by the applicant for Unit No. 2, it is difficult for the staff to tie down specific costs for construction and operation of an alternate cooling system for Unit No. 2.