SOUTHERN CALIFORNIA EDISON COMPANY

316(b) PROGRAM STUDY PLAN

APRIL 1979

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1.0 INTRODUCTION

Section 316(b) of the 1972 Amendments to the Federal Water Pollution Control Act requires that the location, design, construction and capacity of cooling water intake structures reflect the Best Technology Available (BTA) for minimizing adverse environmental impact. The Environmental Protection Agency is responsible for enforcing this section of the act. In California the authority for this responsibility has been delegated to the State Water Resources Control Board and its 9 Regional Boards. The Southern California Edison Company is required to provide the necessary technical information for the 316(b) decision making process. The purpose of this document is to: 1) explain the systematic process SCE plans to utilize to provide this information for site specific BTA determinations; 2) present criteria upon which BTA determinations can be made; and 3) provide a schedule for completing the 316(b) demonstrations.

To arrive at a BTA decision for each of the 8 SCE coastal generating stations, the following procedure will be followed: Existing intake systems available to SCE will be evaluated for their effectiveness in engineering reliability and protection of key biological resources. Since the measure of protection afforded by a given intake technology can only be judged by its reduction of impact on the key fish resource in question, an important component of this study plan is to develop an index of biological effectiveness for feasible technologies. The decision of what is BTA will be derived from weighing the financial costs of specific alternate intake technologies and the relative environmental benefits of using those technologies as expressed in the index of biological effectiveness (See Section 4.1).

This study plan presents: a) a hierarchial system for determining which technologies will undergo a detailed cost analysis and ranking evaluation of biological effectiveness; b) the objectives of eleven projects designed to supply necessary information for making BTA decision, c) a logic schedule for implementation of the 316(b) demonstration (Figure 1), and d) the manner in which the cost/benefit analysis will be performed (Fig. 2).

2.0 INTAKE TECHNOLOGY EVALUATIONS

There are 21 available technologies listed in the April 1976 EPA Intake Development Document. Each of these intake technologies will be evaluated for practicality of application and, if practical, their ability to provide biological protection.

2.1 Engineering Evaluation

An engineering review of all of these available technologies will be developed. Any technology that shows no retrofit feasibility at any level will be eliminated from further evaluation. A detailed literature search of technical publications and user contacts will be used to define the operational and design characteristics of alternate intake designs. This study will involve hydraulic tolerance considerations of the cooling system and identification of structural characteristics necessary to implement a retrofit.

The development of engineering analysis of both available technologies and the existing SCE power plants will enable a comprehensive screening to identify which alternate technologies are compatible as a retrofit design for each plant.

Alternate intake designs shown to be compatible for retrofit will be again evaluated for reliability based on site-specific differences.

Those alternate intake system designs demonstrating reliability and compatibility will be evaluated for cost. The costs of the device, design, demolition and construction costs, plant outage during construction and potential cost due to loss of plant efficiency will be studied for each plant.

Those systems where the engineering design is dependent upon biological parameters (eg. optimum approach velocity controlled by the size of the structure) will be evaluated for cost upon completion of the biological evaluations discussed in the next section. Feasible technologies will be ranked by retrofit cost. Infeasible technologies will be eliminated from further consideration.

2.2 Biological Effectiveness Evaluation

Those designs demonstrating engineering compatibility for retrofit at any or all of SCE coastal plants will be evaluated for potential protection of marine biota beyond that existing in the present intake design.

A detailed literature review of biological studies on intake technologies will be conducted in order to determine whether devices remaining for consideration after engineering screening have merit and warrant additional attention. The review will consider the potential effectiveness in protecting those important species indigenous to the Southern California coastal environment.

Presently, the SCE intake systems utilize state-of-the-art intake technology, including velocity caps and the soon to be operated fish guidance and return system at our San Onofre Station Units 2 and 3. The biological protection afforded by these designs will be determined by testing: a) velocity caps under normal and reversed flow operation and b) the effectiveness of the new fish guidance and return systems.

Man-made structures function as artificial reefs, attracting many biota. The attractiveness factor will be evaluated in terms of BTA and minimization of impact to the environment.

In addition to intake hardware, the feasibility of plant operation modifications during periods of higher biological effect of the plant will be studied (eg. nighttime). Alteration of circulating water system flow rate and modification of heat treatment cycles will be investigated.

Studies conducted on velocity caps, return system, attractive features of the intake and modification to plant operations will be conducted at selected sites, but will be interpreted for possible system-wide application to those plants compatible with that technology.

Other engineeringly feasible alternative intakes will be evaluated in laboratory and field testing to determine whether the design or placement of the device will act to safely exclude or return larval/adult fish. Devices in this category have been identified as "larval exclusionary devices" and will include porous dike, fine mesh and profile wire screens.

The experimental results will enable us to decide whether there is merit in considering any of these technologies as BTA.

These approaches will enable all alternative intake technologies to be evaluated for: a) functional reliability, b) compatability and c) biological protection for site specific applications. Infeasibility at either of those three evaluation levels will selectively eliminate a technology from additional consideration.

3.0 AVAILABLE FISHERY STOCKS

Measurements of losses incurred through impingement and entrainment of organisms are much more meaningful if they can be compared to available stock. Studies will be performed to estimate the available stock of entrainable and impingable ichthyoplankton and adult fish.

3.1 Key Fish Species of Concern

Surveys of species at risk in the water body and the actual patterns of withdrawal as determined physically (eg. flow into intake) and biologically (eg. from impingement records) have been reviewed to determine the focal key species of the study. For example, kelp bass an important sport fish, is impinged in relatively low numbers. However, immediately after spawing at night, their eggs are distributed throughout the water column, at which time the eggs may be entrained in substantial numbers. From considerations such as these, the list of key species (Table 1) has been compiled.

TABLE 1. KEY FISH SPECIES OF CONCERN

Anchovy Queenfish White surfperch Walleye surfperch Shiner surfperch White croaker	90% of impinged Fish
Kelp bass Barred Sand bass Sargo Spotfin Croaker Boccacio Pacific Butterfish	Sport & commercial interest

3.2 Evaluation of System Effects

Near field community components, far field populations and production estimates will be made. Site specific studies will be performed to evaluate the effect of the individual station on the immediate environment and provide generic data to attempt to define production in the Southern California Bight for the entire system. Those generating stations which are biologically similar. Will be studied at a representative site. For specific studies, the following stations are similar: 1) Ormond, El Segundo, Huntington; 2) Alamitos, Mandalay; 3) Redondo 1-4, 5-6, 7-8; 4) San Onofre 5) Long Beach.

The available fishery stock can be reduced by natural and artificial mortalities. Natural mortality can be attributed chiefly to predation within the food chain. Most artificial, or man-induced mortality is due to sport and commercial fishing. However, water intake systems do reduce the fishery resource by some lesser amount.

For impingables (i.e., fish) the resource loss due to intake system operation will be estimated at each plant. For entrainables (planktonic forms) the loss will be extrapolated from information collected at representative plants with similar characteristics.

Losses will be compared to fishery stock estimates of near field populations and estimates of the entire populations of the Southern California Bight.

4.0 ANALYSIS FOR BEST TECHNOLOGY AVAILABLE

The demonstration plan has thus far defined, in general terms, the methodology by which the engineering and biological feasibility and cost of alternate intake technologies, the available biological resource, and the fishing mortality attributable to each generating station will be ascertained. In making an evaluation of BTA we will develop a "cost-benefit" decision graph describing the biological benefits obtainable using specific technologies and cost information for each generating station.

4.1 Cost Benefit Analysis

The necessary technical criteria to be assembled for a BTA decision are: 1) the cost of the intake technology and 2) the relative biological effectiveness of the technology. Cost information relative to feasible intake alternatives will represent a range from no technology to the most sophisticated and costly technology. The biological attribute of a specific technology will be presented as an index of biological effectiveness. The index will relate the estimated population resource of a species in terms of production to cooling system losses as adjusted for intake technology effectiveness. In general, the Biological effectiveness index =

$$\frac{\text{Losses (per year)} \times \text{Withdrawal Reduction Coefficient}}{\text{Production (per year)}}$$

This approach will be taken for each plant based upon site-specific and generic biological data accumulated for "key species" and generic studies of alternate intake technologies.

The basic engineering and biological inputs necessary for BTA decisions will be tabulated and ultimately summarized in a final cost/benefit curve, such as the following conceptualized example Figure 2). We must consider the possibility that one technology may be beneficial in conserving one fish species at the cost of another species. Therefore, we will consider the biological and social "value" of different species. This interpretation may be

site specific for ubiquitous animals or integrated for the entire SCE system.

Because the SCE offshore intakes are in essence artificial reefs, they are attractive to fish. It may well be found that there are enhancing aspects of certain technologies while there is little or no decrease in resource loss due to the fishing effect of the station intake system. The positive aspect in enhancement to the index of environmental benefit would therefore be added.

4.2 Reporting

Cost/benefit presentations for each generating station will be derived from site specific and generic sources. Cost/benefit relations will be summarized for all plants in the existing coastal system to give the broadest perspective to intake impacts.

Once the biological and engineering inputs are complete, the BTA will be proposed. This judgement will include factors such as system reliability, corporate finances, effect of technology choices on coastal siting options, legal and social implications of technology choices, social biological value of key species.

5.0 PROJECT INTEGRATION

A total of eleven projects have been designed to provide defensible information for a BTA decision. They can be more generally categorized into 3 major objectives: 1) intake technology for engineering and biological information; 2) assessment of the available resources to assign resource losses attributable to each power plant and (3) assembly of a sound 316(b) decision package. The objectives and the contributions of information from individual projects are the following (These are referenced in the Logic schedule, Figure 1):

5.1 Intake Technology Evaluation

A) Determine alternate intake technologies compatible for retrofit to the present SCE coastal system.

- o Review of Existing Intake Technology/Alternate technologies
- o Larval Fish Exclusion/Engineering Evaluation

B) Provide a cost analysis for all compatible alternate intake technologies at all stations

- o Review of Existing Intake Technology/Cost Analysis

C) Evaluate the Exclusion effectiveness benefits of existing SCE technology

- o Adult Fish Exclusion
- o Impingement Inventory/Exclusion effectiveness
- o Ichthyoplankton Entrainment Inventory/Exclusion effectiveness
- o Fish Encounter/Exclusion effectiveness
- o Habitat Modification/Exclusion effectiveness

D) Determine exclusion effectiveness of utilizing usable technologies from (A)

- o Review of Existing Intake Technology
- o Larval Fish Exclusion/Withdrawal Effectiveness
- o Adult Fish Exclusion

E) Determine Projected Operational Maintenance Reliability Costs for technologies feasible from D&A

- o Review of Existing Intake Technology

F) Determine change operational effectiveness for existing SCE technology

- o Review of Existing Intake Technology/Operational effectiveness

5.2 Biological Effectiveness Evaluation

A) Define fishery resource at risk of the near-field community at all plants

- o Ichthyoplankton Entrainment Inventory/Fishery Resource
- o Habitat Modification/Fishery Resource
- o Fish Encounter/Fishery Resource

B) Determine Intake Withdrawl Patterns

- o Intake Selectivity
- o Ichthyoplankton Ent. Invent/Withdrawl Pattern

C) Estimate the total fishery resource available to all plants in the SCE coastal system

- o Fishery Stocks/Available Resource

D) Determine the fishery resource loss attributable to power plant induced mortality at all sites

- o Impingement Inventory/Resource loss
- o Entrainment Mortality
- o Habitat Modification/Fishery Loss
- o Fish Encounter/Fishery Loss
- o Ichthyoplankton Entrainment Inventory/Fishery Loss

E) Compare the resource loss attributable to each power plant to the available resource (A/C)

- o Impingement Inventory/Biological Effectiveness
- o Ichthyoplankton Entrainment Inventory/Biological Effectiveness
- o Entrainment Mortality/Biological Effectiveness
- o Fish Encounter/Biological Effectiveness
- o Fishery Stocks/Biological Effectiveness
- o Habitat Modification/Biological Effectiveness

5.3 Best Technology Available Decision

A) Provide costs of feasible retrofit and SCE technology at each station

- o Review of existing intake technology/BTA Decision

B) Develop index of biological effectiveness for all feasible retrofit and SCE technologies at each station using "key species"

- o Fishery Stocks/IBE
- o Adult Fish Exclusion/IBE
- o Larval Fish Exclusion/IBE
- o Impingement Inventory/IBE
- o Habitat Modification/IBE
- o Entrainment Inventory/IBE
- o Fish Encounter/IBE

C) Provide narrative of A&B for each plant.

- o Document Preparation

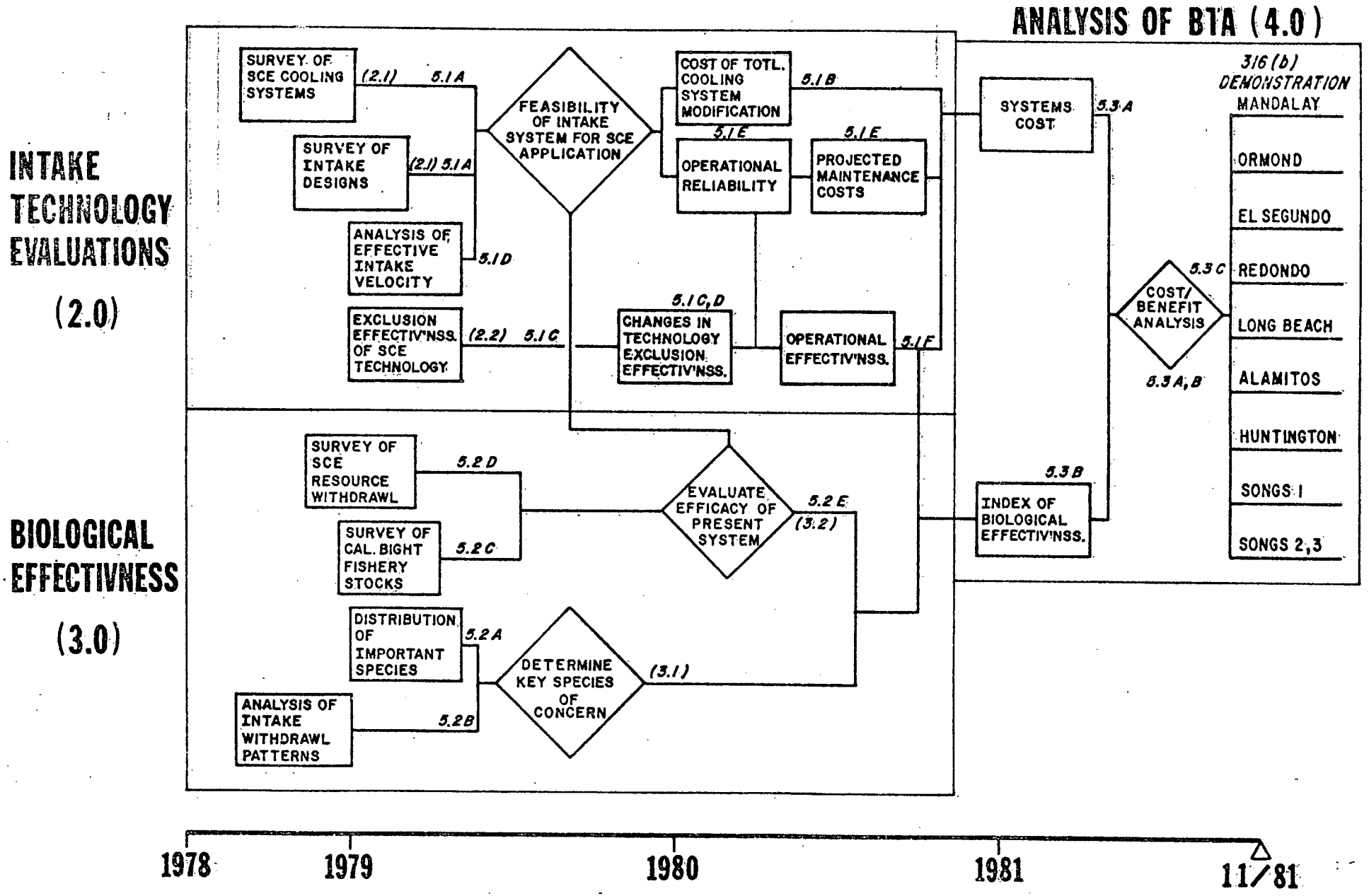
BIOLOGICAL EFFECTS REPRESENTATIVE STUDY SITES

STUDY	LOCATION							
	M	O	ES	R	LB	A	HB	SONGS
PLANKTON								
o ZOOPLANKTON**		X		X	X		X	X
o ICHTHYOPLANKTON								
ENTRAINMENT		X		X		X		X
INVENTORY	SOUTHERN CALIFORNIA BIGHT							
LOSS								X
NEKTON								
o IMPINGEMENT	X	X	X	X	X	X	X	X
o ENTRAPMENT/DENSITY		X	*				X	*
o FIELD ABUNDANCE		X	X	X			X	X
o FISHERY STOCK ESTIMATES**	ALL DATA							
EXISTING TECHNOLOGY								
o VELOCITY CAP							X	
o FLOW							X	
o HEAT TREATMENT							X	
o INTAKE ATTRACTIVENESS			X	X			X	

** USE OF EXISTING DATA

* TO BE DETERMINED

FIGURE 1. SCE 316 (b) PROGRAM PLAN



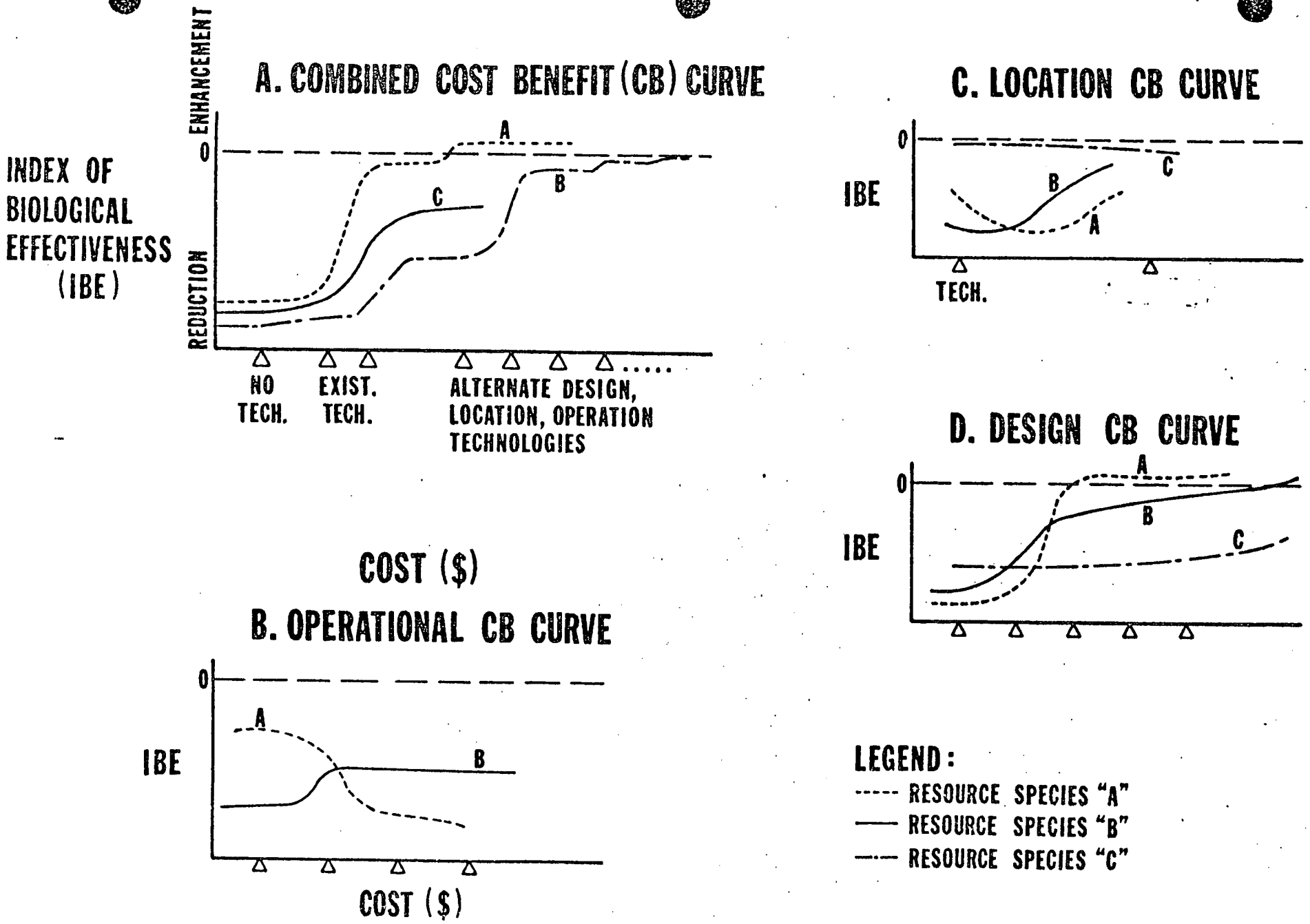


FIGURE 2: CONCEPTUAL COST-BENEFIT CURVE