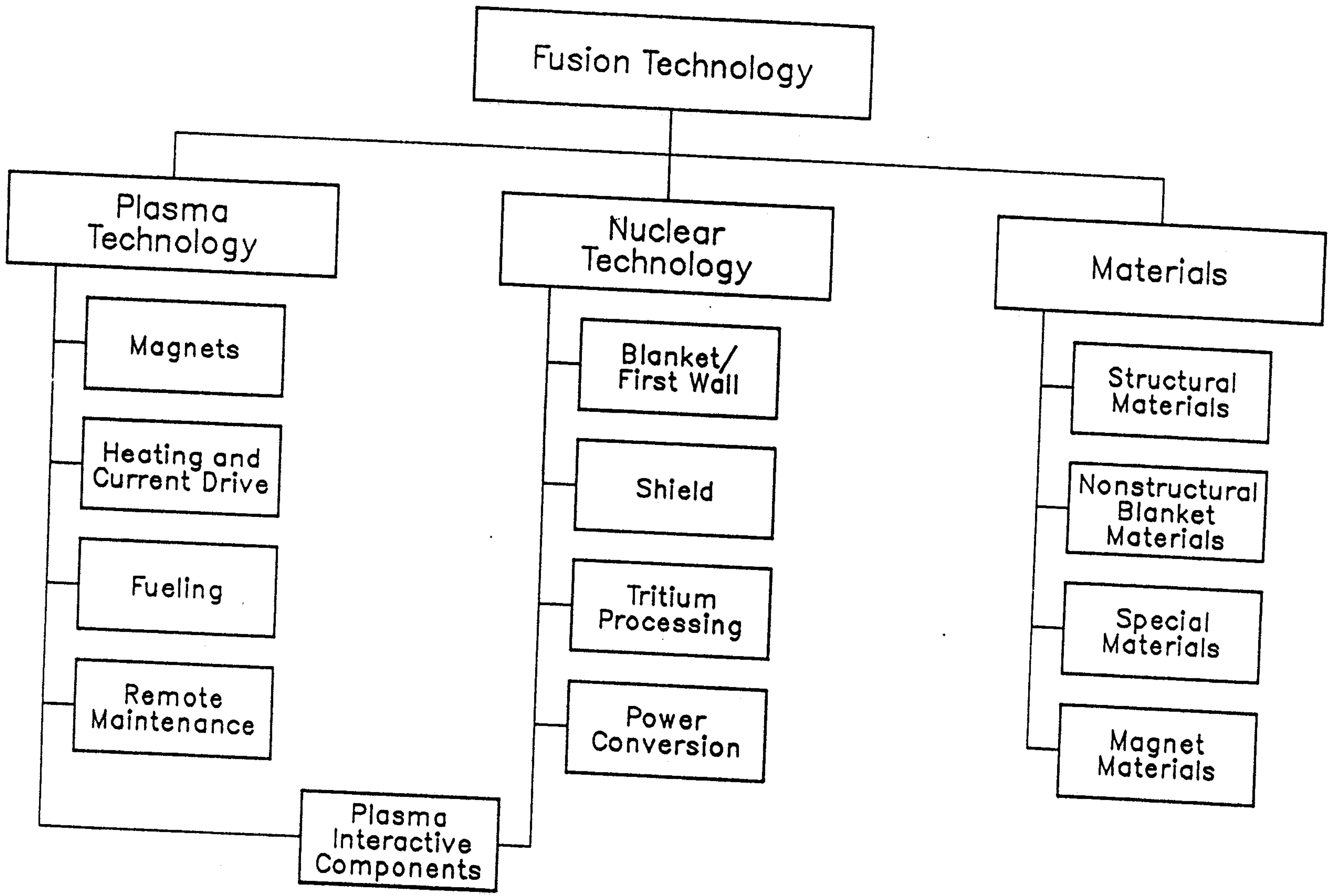
TPA TECHNOLOGY STATUS

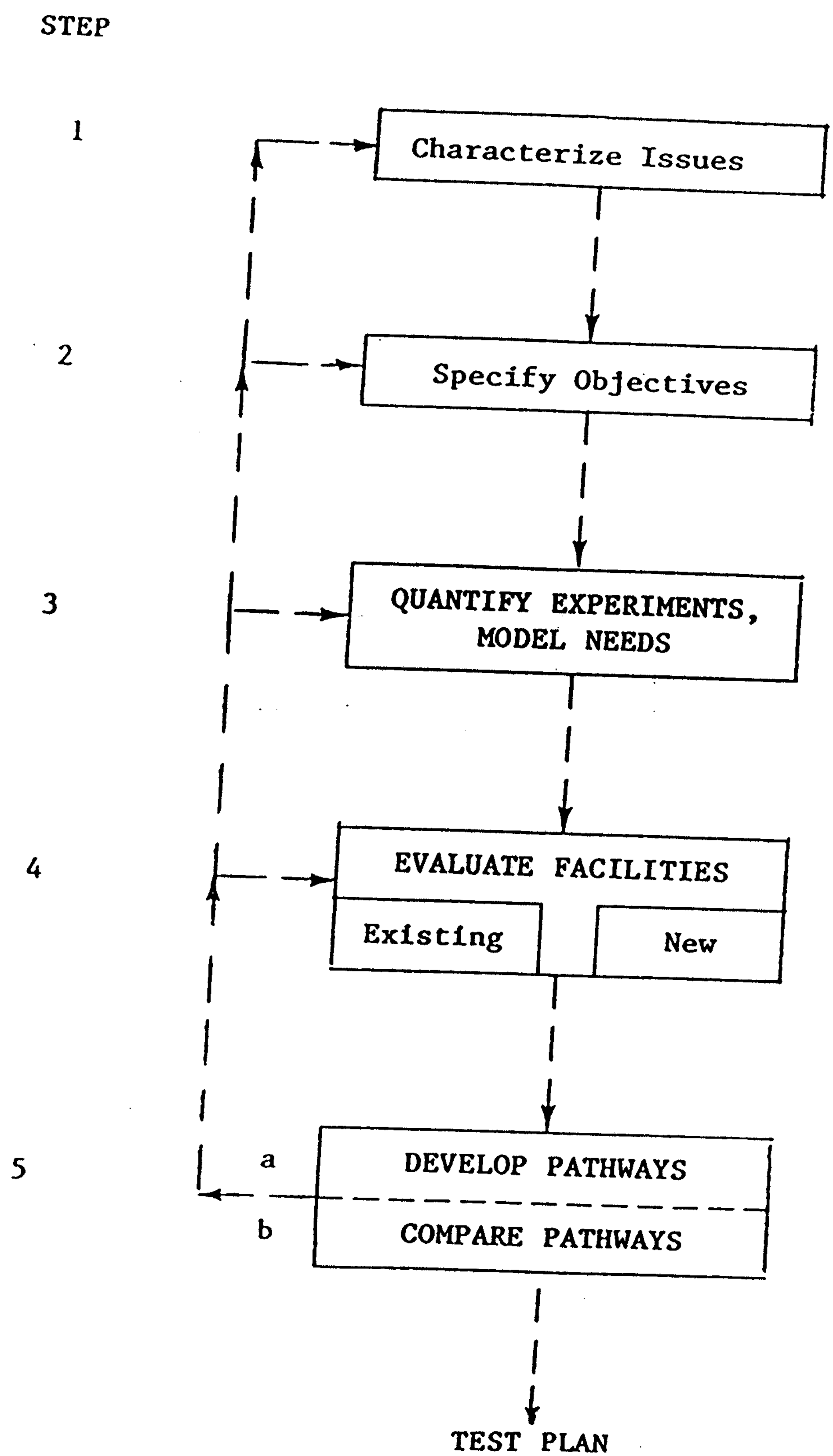
PRESENTATION TO THE TPA INDUSTRIAL
ADVISORY COMMITTEE

MOHAMED ABDOU

15 JANUARY 1986


Fusion Technology
Plasma Technology
Nuclear Technology
Materials
Magnets
Heating and Current Drive
Fueling
Remote Maintenance
Blanket/ First Wall
Shield
Tritium Processing
Power Conversion
Structural Materials
Nonstructural Blanket Materials
Special Materials
Magnet Materials
Plasma Interactive Components

TPA TECHNOLOGY METHODOLOGY STEPS



TPA TECHNOLOGY STATUS SUMMARY

- COMPLETED STEPS 1 AND 2
  - CHARACTERIZE ISSUES
  - SPECIFY OBJECTIVES
- INTERIM REPORT IS BEING REVIEWED
- PHASE II WILL FOCUS ON STEPS 3-5
  - MAJOR EXPERIMENTS AND FACILITIES
  - TECHNICAL LOGIC NETWORK

DEFINITION OF ISSUE?

- Difficult to Develop Precise Meaning

- Often used to convey <u>different</u> meanings:

  <u>Problem</u>

  Uncertainty with Negative Consequence

  <u>Element</u>

  Technical Area, Topic

- <u>Seldom</u> used to mean <u>positive</u>

ISSUE CHARACTERIZATION ITEMS IN TECHNOLOGY REPORT

1. DESCRIPTION

2. POTENTIAL IMPACT ON DESIGN

   - FEASIBILITY

   - ATTRACTIVENESS

3. DESIGN SPECIFITY

   HOW GENERIC/SPECIFIC RELATIVE TO

   - CLASS OF DESIGNS

   - TECHNOLOGY COMPONENT

   - CONFINEMENT CONCEPTS

4. OVERALL LEVEL OF CONCERN

   OVERALL IMPORTANCE TO FUSION

   COMPOSITE: BASED ON 2, 3 AND OTHER FACTORS

POTENTIAL IMPACT ON DESIGN

Feasibility Issues

- May Close the Design Window
- May Result in Unacceptable Safety Risk
- May Result in Unacceptable Reliability, Availability or Lifetime

Attractiveness Issues

- Reduced System Performance
- Reduced Component Lifetime
- Increased System Cost
- Less Desirable Safety or Environmental Impact

FINESSE

EXAMPLES OF ISSUES

PRIMARY ISSUES FOR MATERIALS

- RADIATION EFFECTS ON MATERIALS PROPERTIES
  - MECHANICAL
  - THERMOPHYSICAL
  - THERMOCHEMICAL
  - OTHERS
- BASELINE (UNIRRADIATED) PROPERTIES
  - NECESSARY FOR SCOPING PRIOR TO IRRADIATION
- FABRICATION/JOINING

PRIMARY ISSUES FOR BLANKET

LIQUID METAL

- MHD EFFECTS
- COMPATIBILITY
- IRRADIATION EFFECTS
  STRUCTURE

SOLID BREEDER

- TRITIUM RECOVERY, INVENTORY
- THERMOMECHANICAL INTERACTIONS
- IRRADIATION EFFECTS
  STRUCTURE/BREEDER/M

- FUEL SELF SUFFICIENCY
- TRITIUM EXTRACTION, CONTROL
- FAILURE MODES AND EFFECTS

PRIMARY ISSUES FOR PLASMA INTERACTIVE COMPONENTS (PIC)

- PARTICLE EXHAUST, RECYCLING
- EROSION/REDEPOSITION
- ENERGY REMOVAL/RECOVERY
- THERMOMECHANICAL LOADING AND RESPONSE
- RADIATION EFFECTS
- TRITIUM PERMEATION AND INVENTORY
- FABRICATION

EXAMPLES OF OBJECTIVES

OBJECTIVE

- IDENTIFIES WHAT MUST BE ACHIEVED AND A DIRECTION FOR ACHIEVEMENT

ATTRIBUTE

- A SPECIFIC OR QUANTIFIABLE PARAMETER TO INDICATE THE DEGREE TO WHICH ITS ASSOCIATED OBJECTIVE IS MET

- VARIETY OF MEASUREMENT SCALES

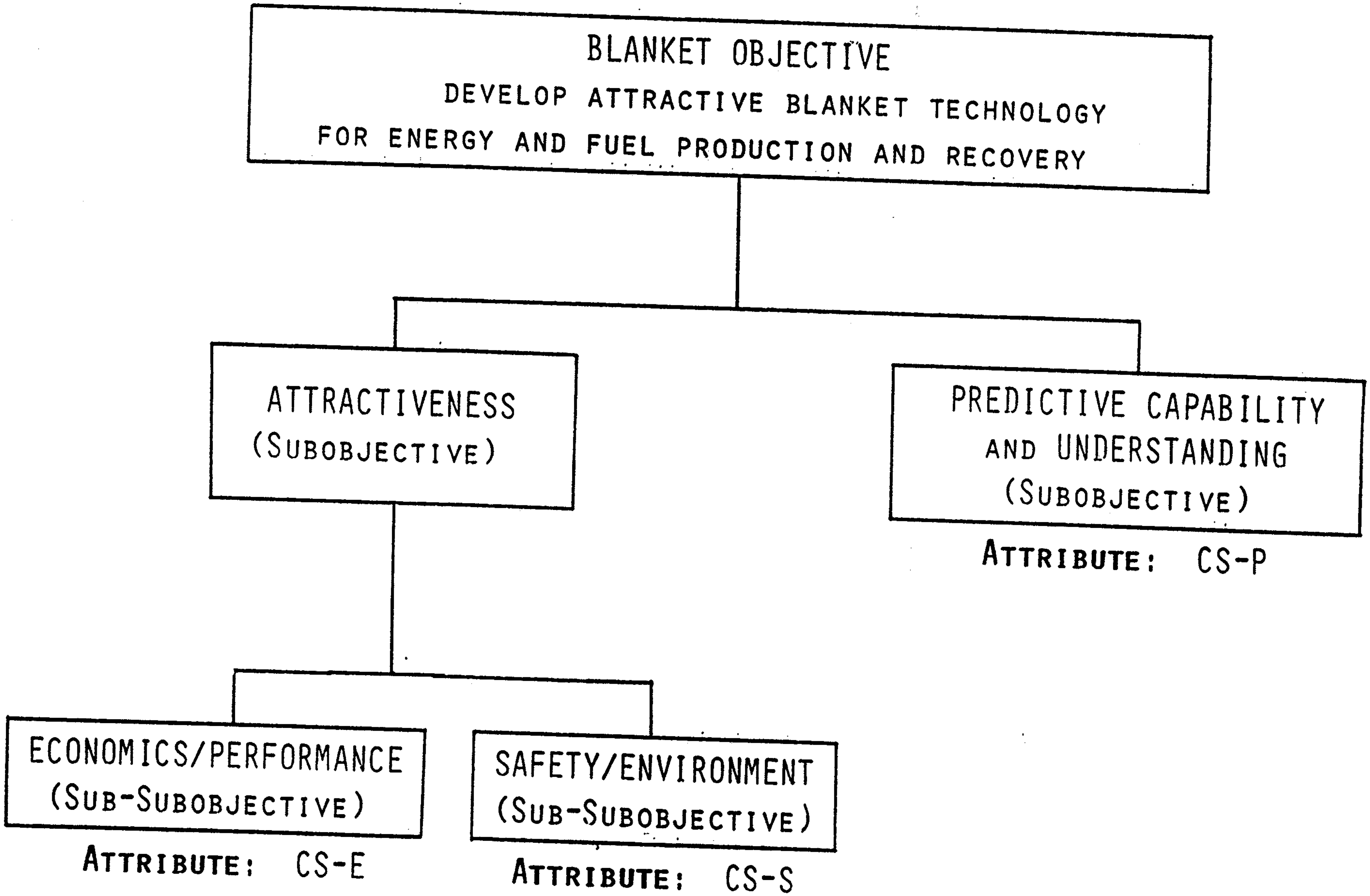
  NATURAL, PROXY, OR CONSTRUCTED

FUSION NUCLEAR TECHNOLOGY

OBJECTIVE

SHOW THAT IT WILL BE POSSIBLE TO DEVELOP ATTRACTIVE NUCLEAR TECHNOLOGY SUBSYSTEMS UNDER CONDITIONS RELEVANT TO FUSION ENERGY SOURCES.

PROVIDE A PREDICTIVE CAPABILITY WHICH CAN BE USED TO ASSESS THE PERFORMANCE OF FUSION NUCLEAR SUBSYSTEMS



BLANKET OBJECTIVE
DEVELOP ATTRACTIVE BLANKET TECHNOLOGY
FOR ENERGY AND FUEL PRODUCTION AND RECOVERY
ATTRACTIVENESS
(SUBOBJECTIVE)
PREDICTIVE CAPABILITY
AND UNDERSTANDING
(SUBOBJECTIVE)
ATTRIBUTE: CS-P
ECONOMICS/PERFORMANCE
(SUB-SUBOBJECTIVE)
ATTRIBUTE: CS-E
SAFETY/ENVIRONMENT
(SUB-SUBOBJECTIVE)
ATTRIBUTE: CS-S

BLANKET ATTRIBUTE
KEY PARAMETERS IN CONSTRUCTED SCALE

ECONOMICS/PERFORMANCE

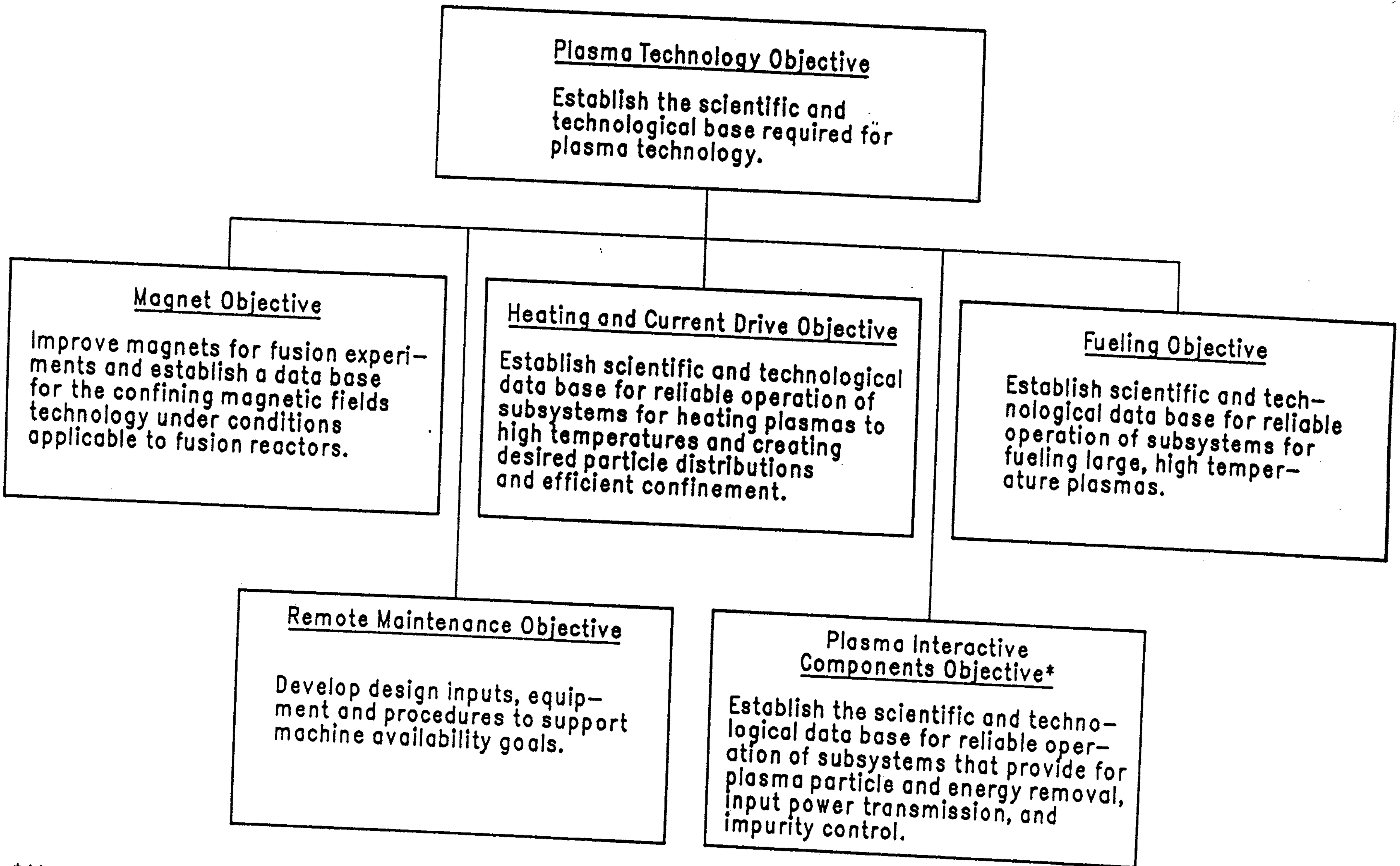
- NEUTRON WALL LOAD
- SURFACE HEAT FLUX
- TRITIUM BREEDING
- THERMAL EFFICIENCY
- ENERGY MULTIPLICATION
- BLANKET THICKNESS
- RELIABILITY
- LIFETIME
- SECTOR MTBF/MTTR
- BLANKET/TRANSPORT LOOP COST

SAFETY/ENVIRONMENT

- CHEMICAL REACTIVITY
- RESPONSE TO LOSS-OF-COOLANT
- VULNERABLE TRITIUM INVENTORY
- LONG-TERM ACTIVATION
- AFTERHEAT
- ROUTINE RADIOACTIVITY RELEASE
- OTHERS

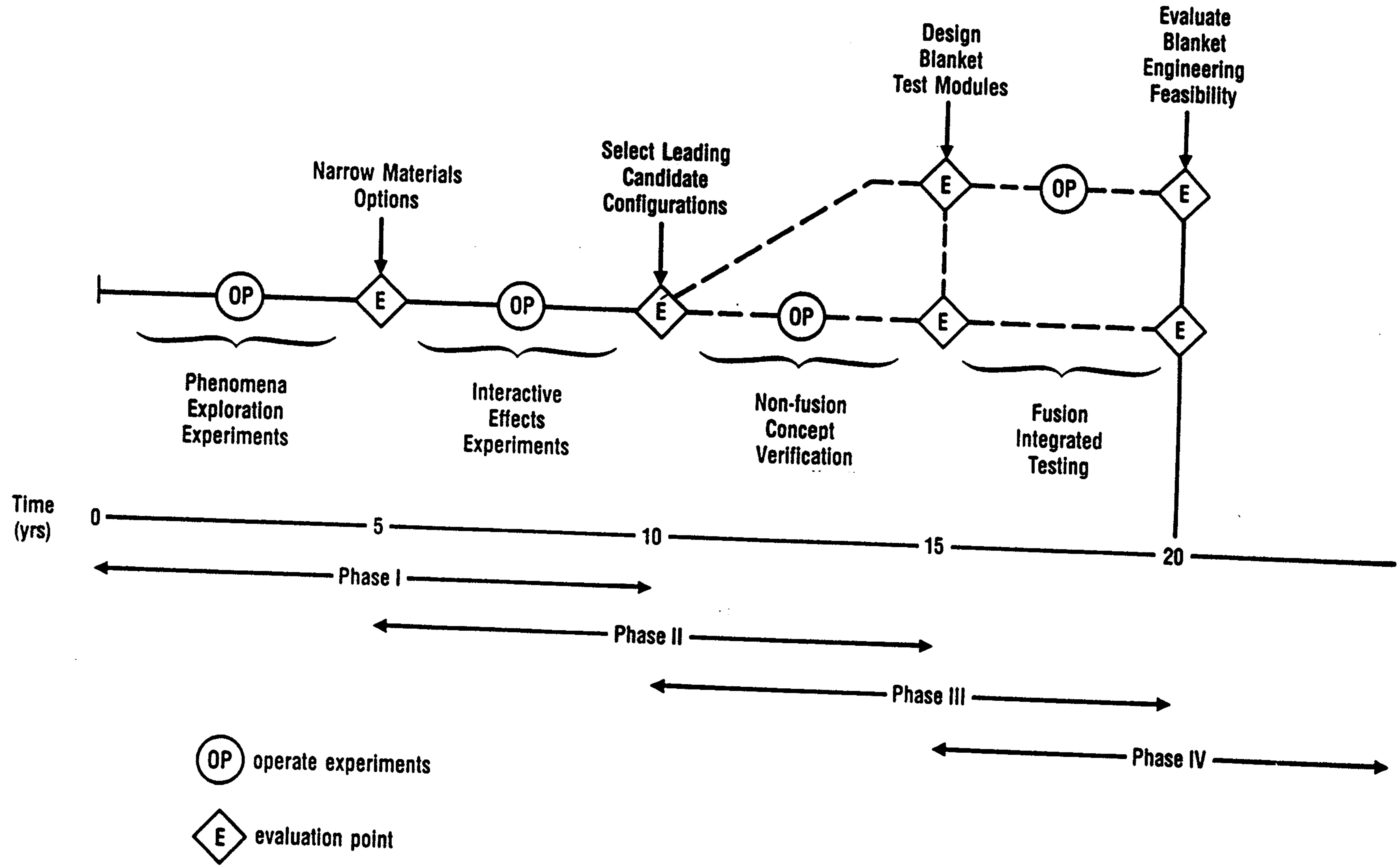
PREDICTION/UNDERSTANDING

- MHD
  - FLUID VELOCITY PROFILE
  - PRESSURE DROP
  - HEAT TRANSFER
  - CORROSION
- TRITIUM INVENTORY
  - SOLUBILITY
  - TRANSPORT
  - ETC.
- MATERIALS INTERACTIONS
  - BREEDER/STRUCTURE
  - COOLANT/STRUCTURE
  - PURGE/BREEDER



*Also shown under Nuclear Technology in Fig. 4.4–1.

EXAMPLES OF PLANNED EFFORT ON EXPERIMENTS, FACILITIES AND TEST PLAN



Design
Blanket
Test Modules
Evaluate
Blanket
Engineering
Feasibility
Narrow Materials
Options
Select Leading
Candidate
Configurations
OP
E
Phenomena
Exploration
Experiments
Interactive
Effects
Experiments
Non-fusion
Concept
Verification
Fusion
Integrated
Testing
Time
(yrs)
0
5
10
15
20
Phase I
Phase II
Phase III
Phase IV
OP operate experiments
E evaluation point

LIQUID BREEDER BLANKET TEST PLAN

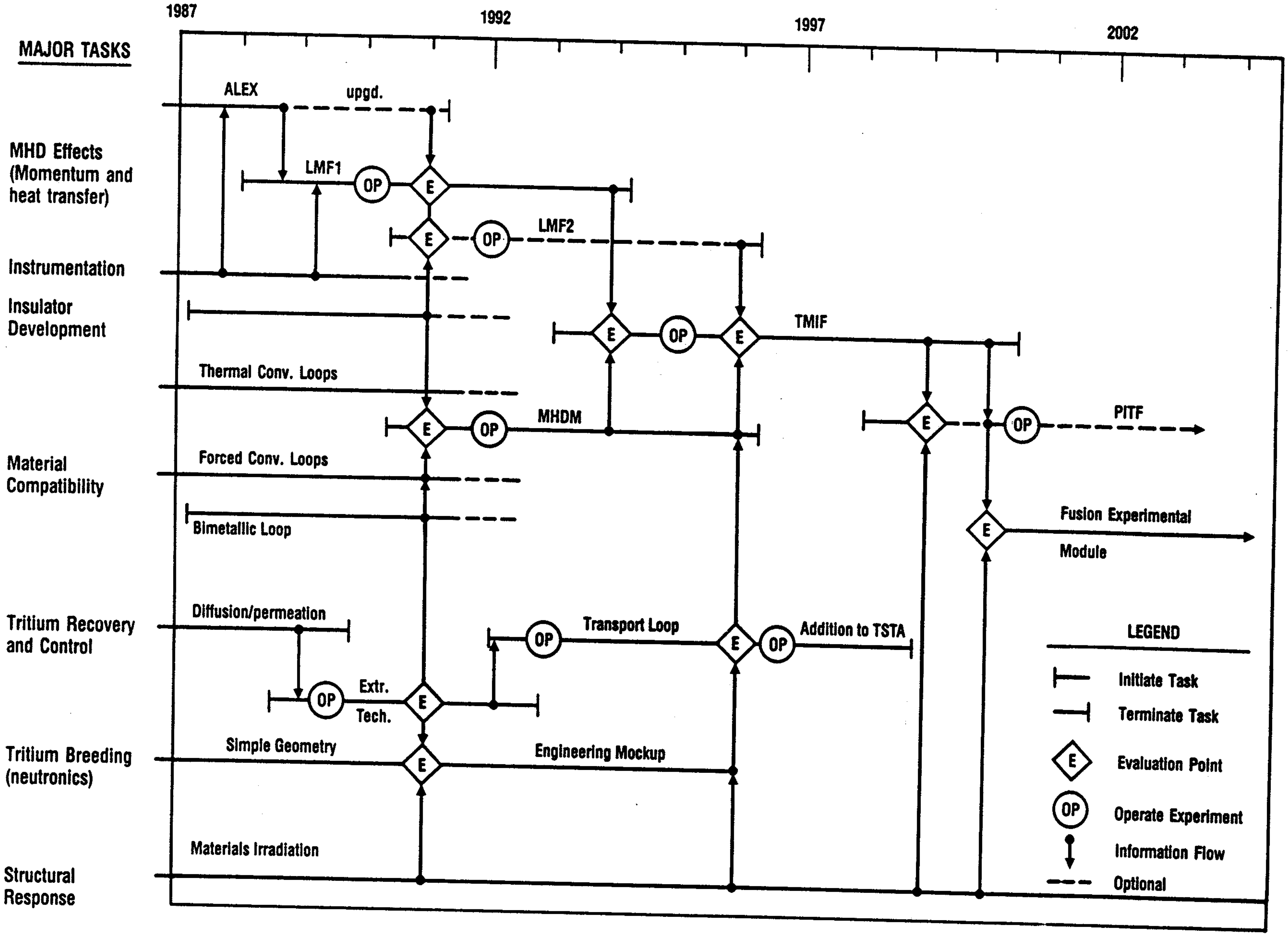


Table 2-23. Representative Costs of Key Liquid Breeder Blanket Facilities

Item	Capital Cost[a] (M$)	Operating Cost[b] (M$/yr)	Duration (years)	Total Cost (M$)
Advanced liquid metal flow facility (LMF1)	7–10	0.5	4–6	10–15
Integral Parameter Experiment (LMF2)	7–10	0.5	4–6	10–15
MHD mass transfer facility (MHDM)	8–12	1.0	6–8	15–20
Thermal convection loops (~4)	2–4	0.8	4–6	5–9
Forced convection loops (~4)	4–6	0.8	4–6	7–11
Tritium extraction test (2)	2–3	0.4	3–4	3–5
Tritium transport loop test	6–8	0.6	5–7	9–12
Thermomechanical Integrated Test Facility (TMIF)	20–25	2.0–3.0	8–10	35–60
Analysis and model development	—	2.0–4.0	15	30–60

[a]In 1985 constant dollars

[b]Does not include analysis of data