TPA FUSION TECHNOLOGY

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TECHNICAL PLANNING ACTIVITY (TPA)

The goal is to develop a methodology for planning the national magnetic fusion program and to prepare technical program plans in support of the strategic and policy framework of the Magnetic Fusion Program Plan (MFPP).

Time Scale: Approximately one year

PLANNING AND IMPLEMENTATION IS A THREE STEP PROCESS

Step 1	Establish policy	MFPP
Step 2	Develop technical plans	TPA and Fusion community
Step 3	Implement plans based on budget and other programmatic considerations	DOE/OFE

MFPP Goal

Establish the Scientific and Technological Base Required for Fusion Energy

TPA plans should support goal and three strategic objectives.

Strategic Objectives

Science Objective	Technology Objective	Technology Transfer Objective
Be able to predict, control and optimize the behavior of plasma confined in fusion relevant magnetic configurations	Show that it is possible to create the unique fusion components and subsystems under conditions relevant to fusion energy sources	Provide a range of options for private sector investment and commercial development of fusion

Plasma Science will be planned with an issue orientation.

Fusion Technology will be planned with a component orientation.

KEY TECHNICAL ISSUES

- Magnetic confinement systems
- Properties of burning plasmas
- Fusion materials
- Fusion nuclear technology

All research and development tasks identified in the TPA should support resolution of the key technical issues.

Key MFPP Features/**Implications for TPA**

"Strategy adopted to reach the program goal must take into account the key technical issues, the schedule for program completion and the available resources."

- **Planning should be based on realistic budget expectations, but should not be overly constrained by budget assumptions.**

"A key feature . . . is . . . its ability to accommodate deviations from planned annual budgets."

- **Avoid centerpiece projects which dominate program expenditures. ("Centerpiece" ≡ > 20% of annual budget or $\gtrsim$ $300K.)**

"The subprogram elements are highly interrelated and are all necessary . . ."

- **Need to maintain a critical effort in all four key technical areas.**

". . . around the year 2000 . . . it would be possible to proceed with the design of an integrated magnetic fusion system . . ." "Fusion Economic and Environment Assessment"

- The MFPP goal can (should?) be interpreted as establishing the scientific and technological base required to design an integrated magnetic fusion system as a major element in an assessment of the economic and environmental aspects of fusion energy.

"The purpose of the U.S. in cooperating internationally is to advance the prospects for establishing a sufficient fusion science and technology base in a timely fashion."

- The planning activity must identify needs and opportunities for effective international collaboration.

- The near-term plans (next 5 years) should support the goal of reaching international consensus on the nature of future test facilities, particular integrated test facilities.

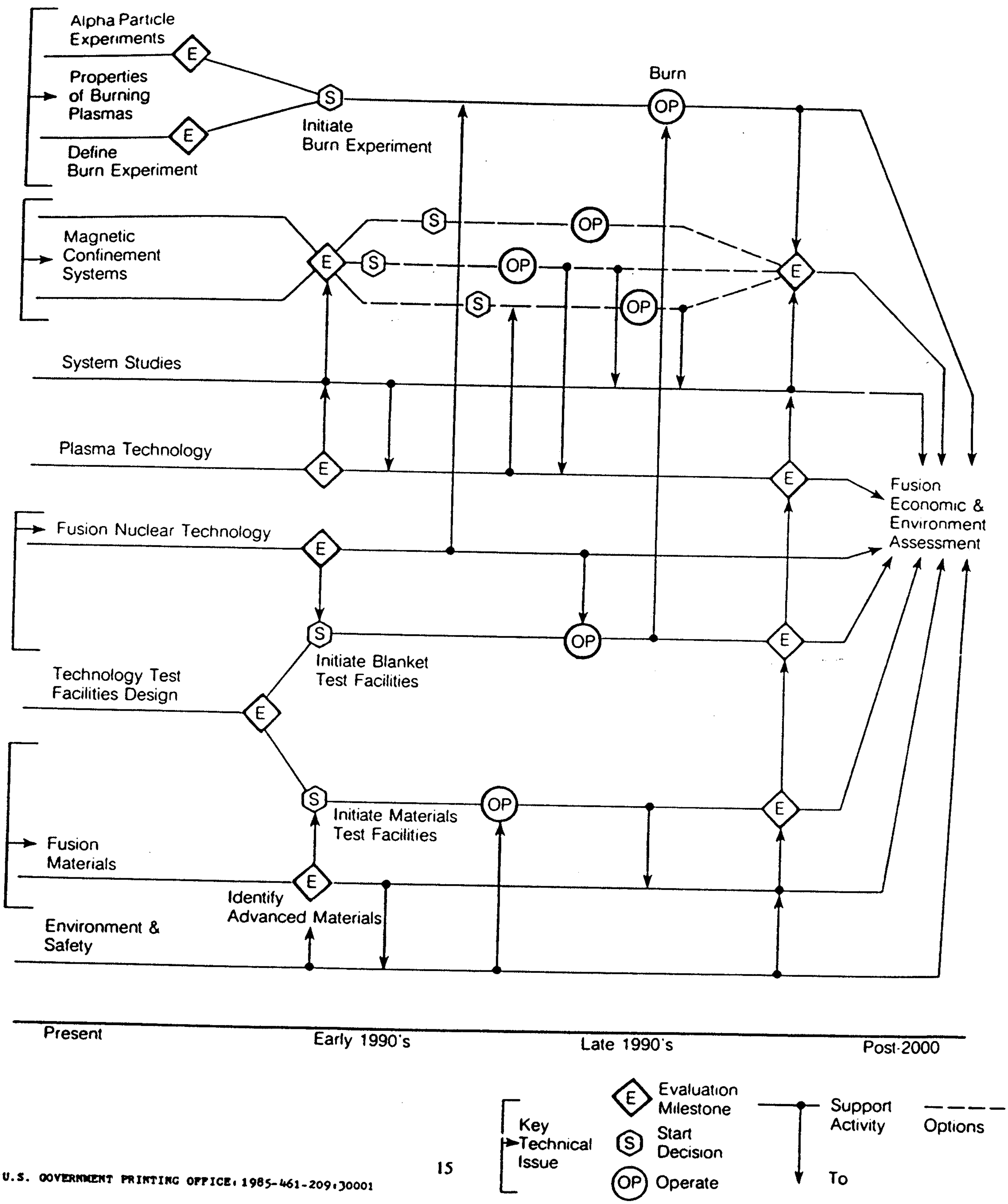
"The MFPP is a strategy for solving fusion's technical problems within a time frame keyed to the resolution of problems in other areas of energy development."

- **Planning horizon is about 15 → 20 years, to the "post-2000" period.**

"During the next five years, a concentrated effort will be made to identify cost-effective component and system test facilities for resolving the key technical issues." [Major decisions around 1990.]

- **Planning emphasis will be placed on next five years. However, a conventional roll-forward approach is not adequate to meet intent of the MFPP.**

Magnetic Fusion Program Plan
Major Technical Milestones and Decisions



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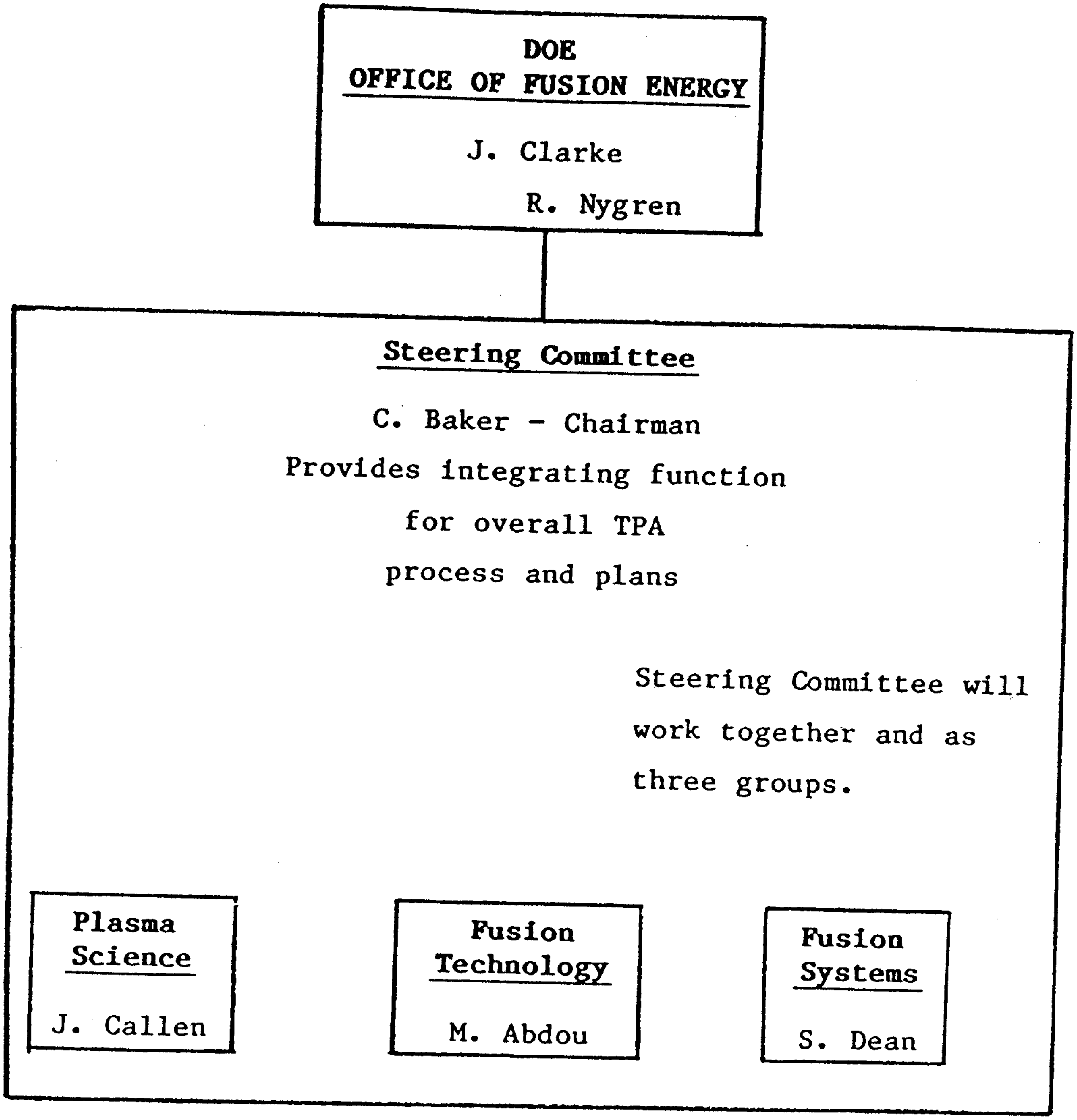


- Each group is composed of about six to eight senior technical experts from the community.

- Groups will utilize additional experts and task groups in the community as required.

TECHNOLOGY STEERING COMMITTEE (TSC)

MOHAMED A. ABDOU (UCLA), CHAIRMAN

LEE A. BERRY (ORNL)

DAVID H. BERWALD (TRW)

JAMES CROCKER (EG&G)

WILHELM B. GAUSTER (SNL)

CARL D. HENNING (LLNL)

MICHAEL KORENKO (WHC/HEDL)

JOHN A. SCHMIDT (PPPL)

DALE L. SMITH (ANL)

HERBERT H. WOODSON (UT)

FUSION TECHNOLOGY CAN BE ORGANIZED IN SEVERAL WAYS

SUBSYSTEMS	TECHNICAL DISCIPLINES	FUNCTIONS	OBJECTIVES
MAGNETS	NUCLEAR PHYSICS	ENERGY EXTRACTION AND CONVERSION	BETTER ECONOMICS
HEATING	NEUTRON TRANSPORT	FUEL PRODUCTION AND PROCESSING	BETTER SAFETY
FUELING	THERMODYNAMICS	PLASMA HEATING	BETTER ENVIRONMENTAL IMPACT
PLASMA INTERACTIVE COMPONENTS	FLUID MECHANICS	PLASMA FUELING	LOWER R&D COST
BLANKET	CHEMISTRY	PROVIDE MAGNETIC FIELD	
TRITIUM PROCESSING COMPONENTS	ELECTROMAGNETICS		
REMOTE MAINTENANCE EQUIPMENT	STRUCTURAL MECHANICS		
POWER CONVERSION SYSTEM	METALLURGY		
	RADIATION DAMAGE		
	NUCLEAR ENGR.		
	MECHANICAL ENGR.		
	CHEMICAL ENGR.		

RELATION OF R&D FOR SUBSYSTEMS
TO THE FOUR TECHNICAL ISSUES WILL BE SHOWN

MFPP Issue \ Subsystem	Magnets	Heating/ Fueling	Blanket	PIC	Tritium	Remote Maint.
Confinement	X	X		X	X	X
Burning Plasma	X	X		X	X	
Materials	X	X	X	X		
Nuclear Technology	X	X	X	X	X	X

FUSION TECHNOLOGY
BASIC ORGANIZATIONAL STRUCTURE
WILL BE BY SUBSYSTEM

MAIN SUBSYSTEMS

- MAGNETS
- HEATING/FUELING
- BLANKET/FIRST WALL
- PLASMA INTERACTIVE COMPONENTS (PIC)
- TRITIUM PROCESSING AND VACUUM SYSTEMS
- POWER CONVERSION SYSTEM
- RADIATION SHIELD
- REMOTE MAINTENANCE EQUIPMENT

ORGANIZATIONAL RESPONSIBILITIES

- MEMBERS OF THE STEERING COMMITTEE (SC) WILL BE COLLECTIVELY RESPONSIBLE FOR DEVELOPING THE KEY ASPECTS OF THE PLAN
- FOR EACH COMPONENT, ONE OR MORE SC MEMBERS WILL LEAD THE DAY-TO-DAY WORK
- FOR EACH COMPONENT, A CORE GROUP OF TECHNICAL EXPERTS WILL DEVELOP THE NECESSARY INFORMATION
- OTHER EXPERTS IN THE COMMUNITY WILL BE CONSULTED; WILL ENSURE THAT DIFFERENT IDEAS, VIEWS, ETC. ARE DISCUSSED
- ONE OR MORE COMMUNITY-WIDE WORKSHOPS WILL PROVIDE USEFUL FEEDBACK AND BUILD CONSENSUS
- PREVIOUS WORK WILL BE USED WHEN AND WHERE RELEVANT
- INPUT FROM EXISTING PROJECTS, STUDIES, TASK GROUPS, ETC. WILL BE SOUGHT

KEY SCM(S)

• MAGNETS	HENNING/BERRY
• HEATING/FUELING	BERRY/SCHMIDT
• BLANKET/FIRST WALL	ABDOU/SMITH/KORENKO
• PLASMA INTERACTIVE COMPONENTS (PIC)	GAUSTER/SCHMIDT
• TRITIUM PROCESSING, VACUUM SYSTEMS	(BARTLIT)
• POWER CONVERSION SYSTEM	HENNING/BERWALD
• RADIATION SHIELD	
• REMOTE MAINTENANCE EQUIPMENT	GAUSTER/KORENKO

A "STRUCTURED" METHODOLOGY/APPROACH WILL BE USED FOR PLANNING TECHNOLOGY

INCENTIVES

- TO ENCOURAGE CREATIVE THINKING ABOUT VARIOUS R&D PATHWAYS (ALTERNATIVES) TO ACCOMPLISH OBJECTIVES

- TO ENCOURAGE UNCOVERING AND UNDERSTANDING KEY ASSUMPTIONS, DECISION POINTS AND LIKELY OUTCOME (CONSEQUENCES) OF VARIOUS ALTERNATIVES

- TO PROVIDE A "COMMON SCALE" FOR COMPARING:

  - VARIOUS ALTERNATIVES

  - RELATIVE "WORTH" OF MAJOR FACILITIES, EXPERIMENTS (FOR EACH COMPONENT, AMONG DIFFERENT COMPONENTS?)

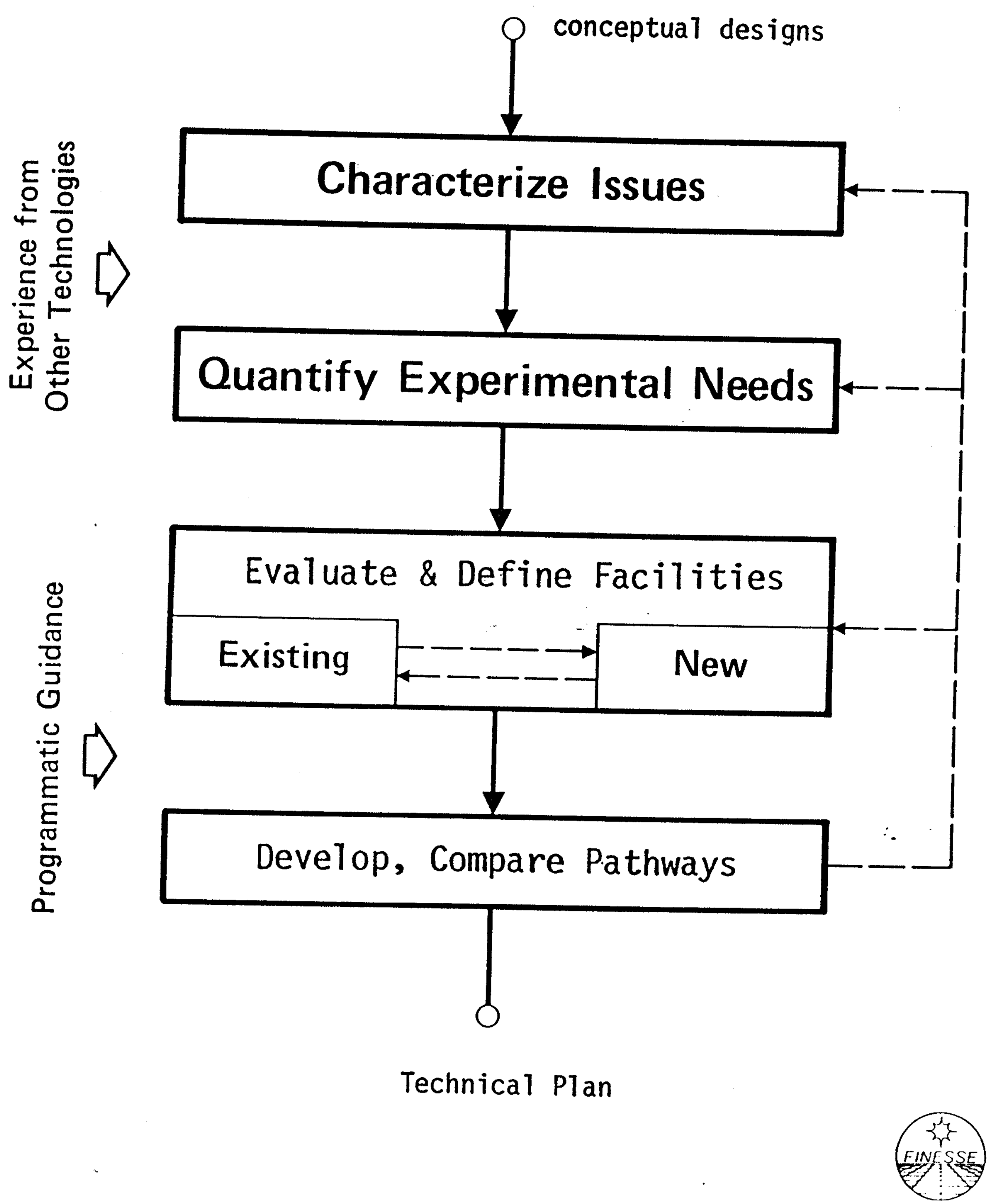
THE "STRUCTURED" PLANNING PROCESS SHOULD POSSESS CERTAIN DESIRABLE CHARACTERISTICS:

- SYSTEMMATIC AND LOGICAL
- DEFENSIBLE
- EXPLAINABLE
- QUANTIFIES THE VALUE OF PROGRAM ELEMENTS VS. OBJECTIVES
- QUANTIFIES SUBJECTIVE JUDGMENTS (E.G., COST, TIME. TECHNICAL UNCERTAINTY)
- FACILITATES CREATION OF CONSENSUS
- ALLOWS FOR CHANGES IN POLICY AND NEW INNOVATIONS

"STRUCTURED" METHODOLOGY

- KEY ELEMENTS OF METHODOLOGY DISCUSSED
- WILL EVOLVE THIS SUMMER
- PRESENTLY TRYING FOR ONE COMPONENT, ON AN "EXPERIMENTAL/LEARNING" BASIS, A PROMISING APPROACH BASED ON:
  - "FINESSE TYPE" PROCESS FOR DEVELOPING ALTERNATIVE PATHWAYS
  - "ANALYTIC-DECISION MAKING" PROCESS FOR COMPARING ALTERNATIVE PATHWAYS

FINESSE PROCESS For Experiment Planning



GENERAL PROCEDURE OF "DECISION ANALYSIS" APPROACH

1. DEFINE AND STRUCTURE THE DECISION PROBLEM.

2. SPECIFY OBJECTIVES AND ATTRIBUTES:
   - A. OVERALL OBJECTIVES FROM MFPP;
   - B. DEVELOP MEASURABLE (SUB)OBJECTIVES FOR EACH TECHNOLOGY COMPONENT;
   - C. DEVELOP ATTRIBUTES (EVALUATION SCALES).

3. DETERMINE PREFERENCES (VALUES) OF DECISION MAKERS.

4. GENERATE ALTERNATIVES.

5. ASSESS THE POSSIBLE CONSEQUENCES OF EACH ALTERNATIVE (DEGREE TO WHICH ALTERNATIVES MEET OBJECTIVES).

6. EVALUATE AND COMPARE ALTERNATIVES (BASED ON DEGREE OF MEETING OBJECTIVES AND PREFERENCES FOR OBJECTIVES).

FUSION TECHNOLOGY GROUP
ACTIVITIES/SCHEDULE

SUMMER 1985

- ORGANIZE SUBGROUPS
- CHARACTERIZE ISSUES
- IDENTIFY, QUANTIFY EXPERIMENTS NEEDED (NOT FACILITIES, BUT MAJOR FEATURES OF EXPERIMENTS, EXPERIMENTAL CONDITIONS) TO RESOLVE ISSUES
- EVOLVE METHODOLOGY FOR PLANNING

FALL 1985

- EVALUATE EXISTING FACILITIES CAPABILITIES AND LIMITATIONS
- CHARACTERIZE, SELECT NEW FACILITIES
- DEVELOP ALTERNATIVE PATHWAYS

WINTER 1986

- COMPARE ALTERNATIVES FOR EACH COMPONENT
- COMPARE "RELATIVE WORTH" AMONG COMPONENTS?
- DEVELOP BASIC ELEMENTS/FEATURES OF TECHNOLOGY TECHNICAL PLAN

SPRING 1986

- FOCUS ON SPECIFIC PLANS FOR NEXT FIVE YEARS WITH MFPP ISSUES ORIENTATION
- REFINEMENT
- WRITING

EXPECTED REPORTS

- INTERIM REPORT, OCTOBER 1985
  CHARACTERIZATION OF ISSUES AND NEEDED EXPERIMENTS

- FINAL REPORT, LATE SPRING 1986