FUSION NUCLEAR TECHNOLOGY
ISSUES, STATUS AND STRATEGY

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PRESENTATION TO MFAC
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ATLANTA, GA

FUSION NUCLEAR TECHNOLOGY
PRESENTATIONS TO MFAC
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A. FNT ISSUES, STATUS AND STRATEGY — ABDOU

- TECHNICAL ISSUES
- BASIC STRATEGY TO RESOLVE ISSUES
- ROLE OF ETR
- GENERAL COMMENTS ON U.S. AND INTERNATIONAL STATUS
- NEAR-TERM NEEDS

B. CURRENT BLANKET TECHNOLOGY ACTIVITIES — BAKER/MATTAS

- SOLID BREEDER EXPERIMENTS
- LIQUID METAL MHD
- CORROSION EXPERIMENTS
- BREEDER NEUTRONICS
- THEORY/MODELLING

C. TRITIUM TECHNOLOGY — ANDERSON

- FUEL PROCESSING
- TRITIUM PERMEATION
- BREEDER TRITIUM EXTRACTION

FUSION NUCLEAR TECHNOLOGY

FUNCTION

- FUEL PRODUCTION AND PROCESSING
- ENERGY EXTRACTION AND USE
- RADIATION PROTECTION OF COMPONENTS AND PERSONNEL

COMPONENTS

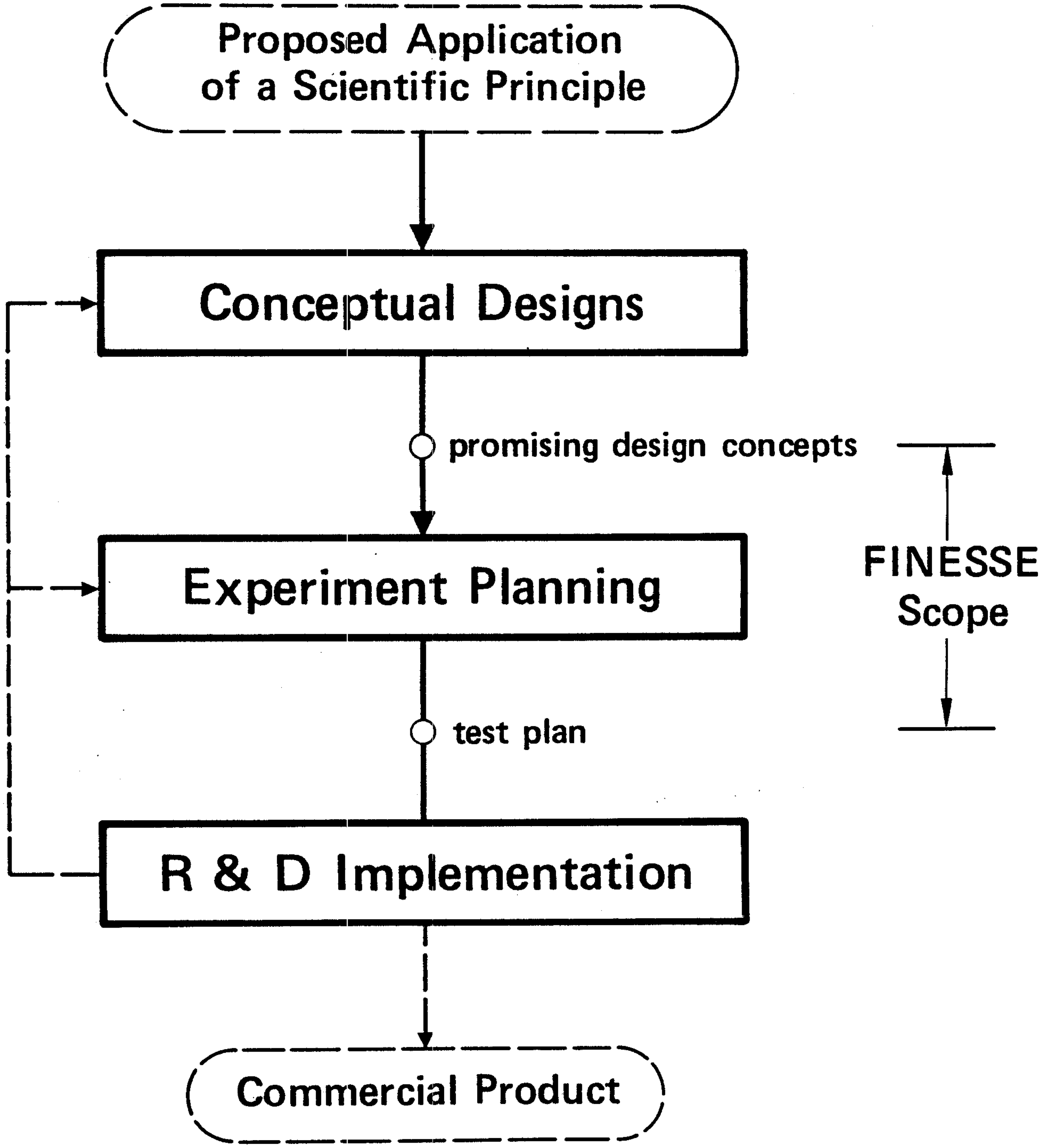
- BLANKET/FIRST WALL
- TRITIUM PROCESSING
- RADIATION SHIELD
- NUCLEAR ELEMENTS OF PIC

INTRODUCTORY REMARKS

- STUDIES PERFORMED DURING THE PAST 3 YEARS HAVE TREMENDOUSLY IMPROVED OUR UNDERSTANDING OF THE KEY ISSUES AND MAJOR NEEDS OF FUSION NUCLEAR TECHNOLOGY
    - FINESSE
    - BCSS
    - OTHERS
- WE NOW:
    - UNDERSTAND THE ISSUES
    - HAVE A PLAN TO RESOLVE THE ISSUES
- **IMPLEMENTATION** IS THE LOGICAL NEXT STEP

EXPERIMENT PLANNING

Is a Key Element of Technology Development



Proposed Application of a Scientific Principle

Conceptual Designs

promising design concepts

Experiment Planning

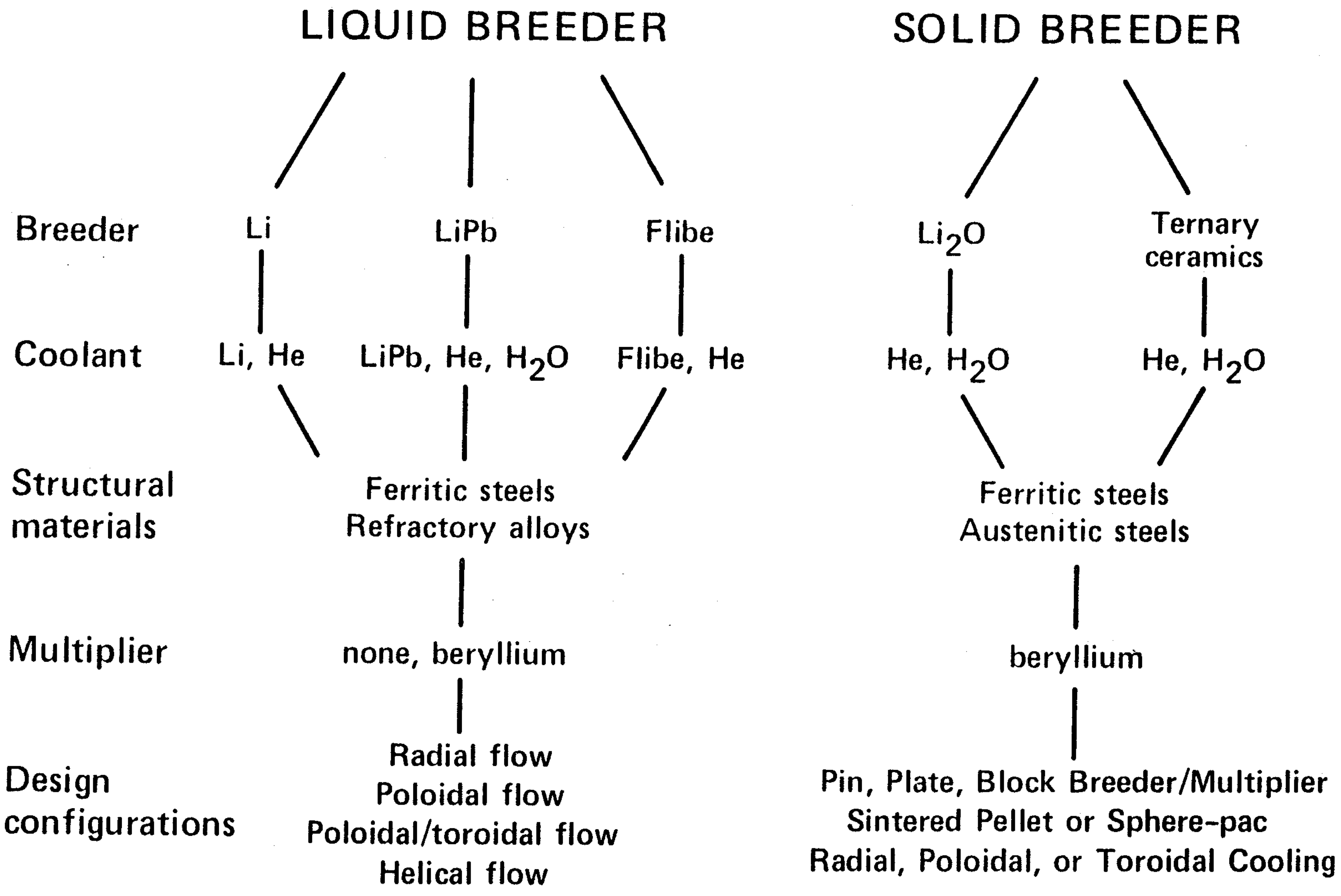
test plan

R & D Implementation

Commercial Product

FINESSE Scope

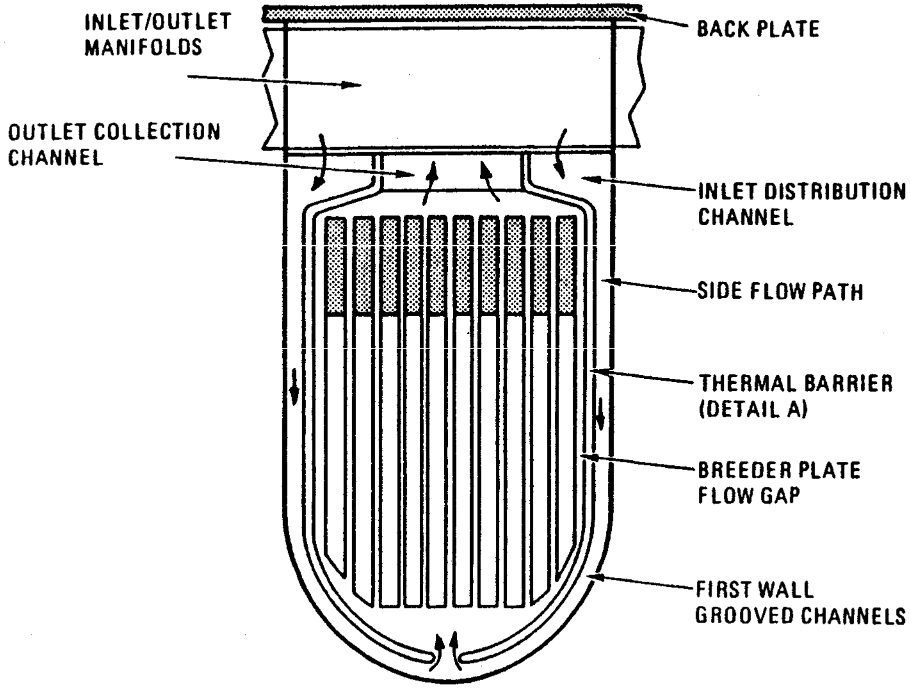
Primary Options
For Blanket Materials and Configurations

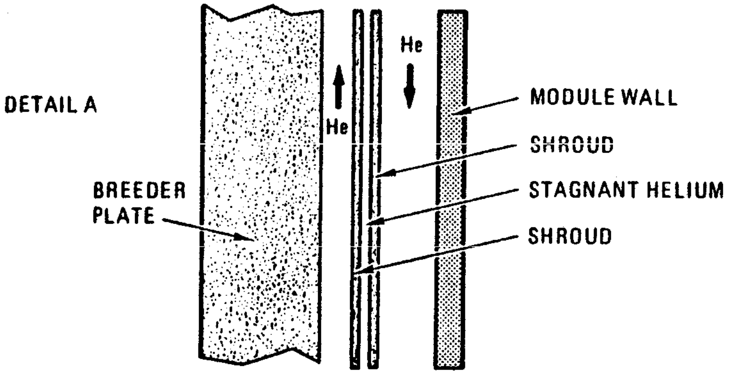


	LIQUID BREEDER			SOLID BREEDER	
Breeder	Li	LiPb	Flibe	Li$_2$O	Ternary ceramics
Coolant	Li, He	LiPb, He, H_2O	Flibe, He	He, H_2O	He, H_2O
Structural materials	Ferritic steels Refractory alloys			Ferritic steels Austenitic steels	
Multiplier	none, beryllium			beryllium	
Design configurations	Radial flow Poloidal flow Poloidal/toroidal flow Helical flow			Pin, Plate, Block Breeder/Multiplier Sintered Pellet or Sphere-pac Radial, Poloidal, or Toroidal Cooling	

Further experimental work is required prior to selection.

Li_2O/He/HT-9 BLANKET





Generic Solid Breeder Blanket Issues

- Tritium Self-sufficiency
  - —Achievable Breeding Ratio
  - —Required Breeding Ratio
- Breeder/multiplier Tritium Inventory and Recovery
- Breeder/multiplier Thermomechanical Behavior
- Corrosion and Mass Transfer
- Structural Response and Failure Modes in Fusion Environment
- Tritium Permeation and Processing from Blanket

TRITIUM FUEL SELF SUFFICIENCY

- CRITICAL REQUIREMENT FOR RENEWABLE ENERGY SOURCE

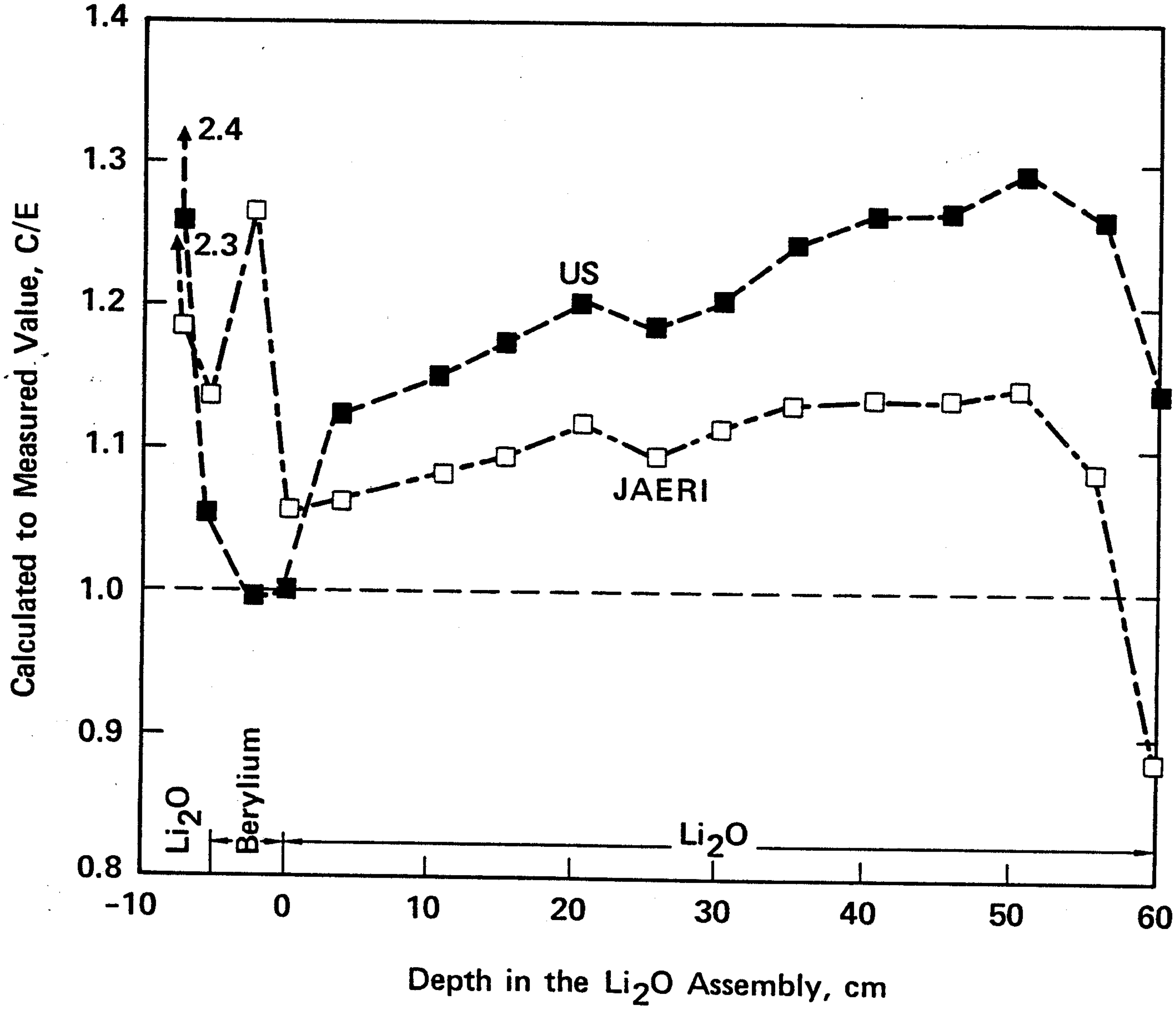
- SELF-SUFFICIENCY CONDITION:

  ACHIEVABLE TBR > REQUIRED TBR

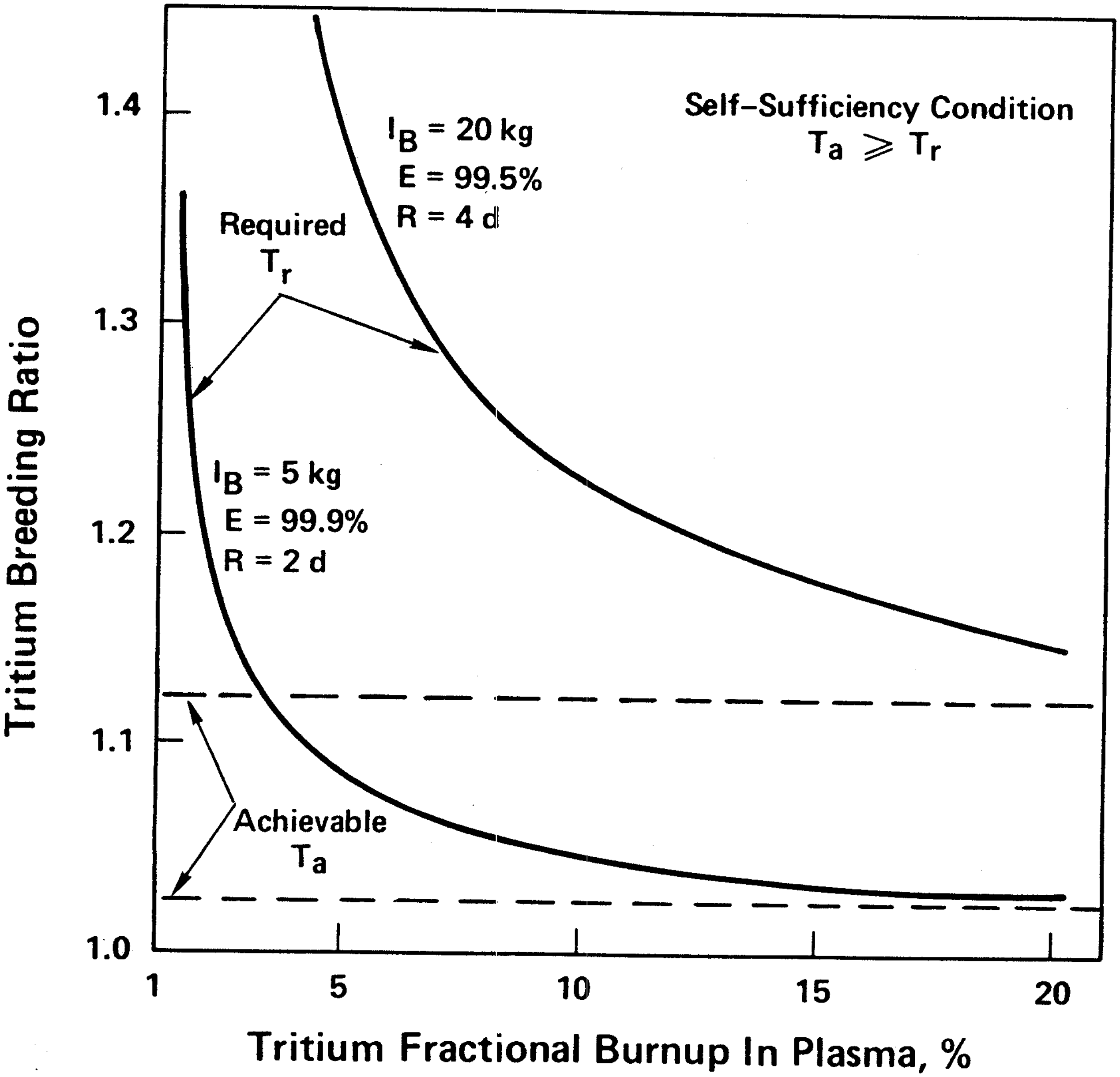
- ANALYSIS SHOWS:
  - T_A AND T_R DEPEND ON MANY SYSTEM PARAMETERS
  - PRESENT UNCERTAINTIES ARE LARGE
  - SUCCESS IS REQUIRED IN BOTH PHYSICS AND ENGINEERING

US/JAERI Neutronics Cooperation Program

Tritium Breeding (^{6}Li): Calculated to Measured Values



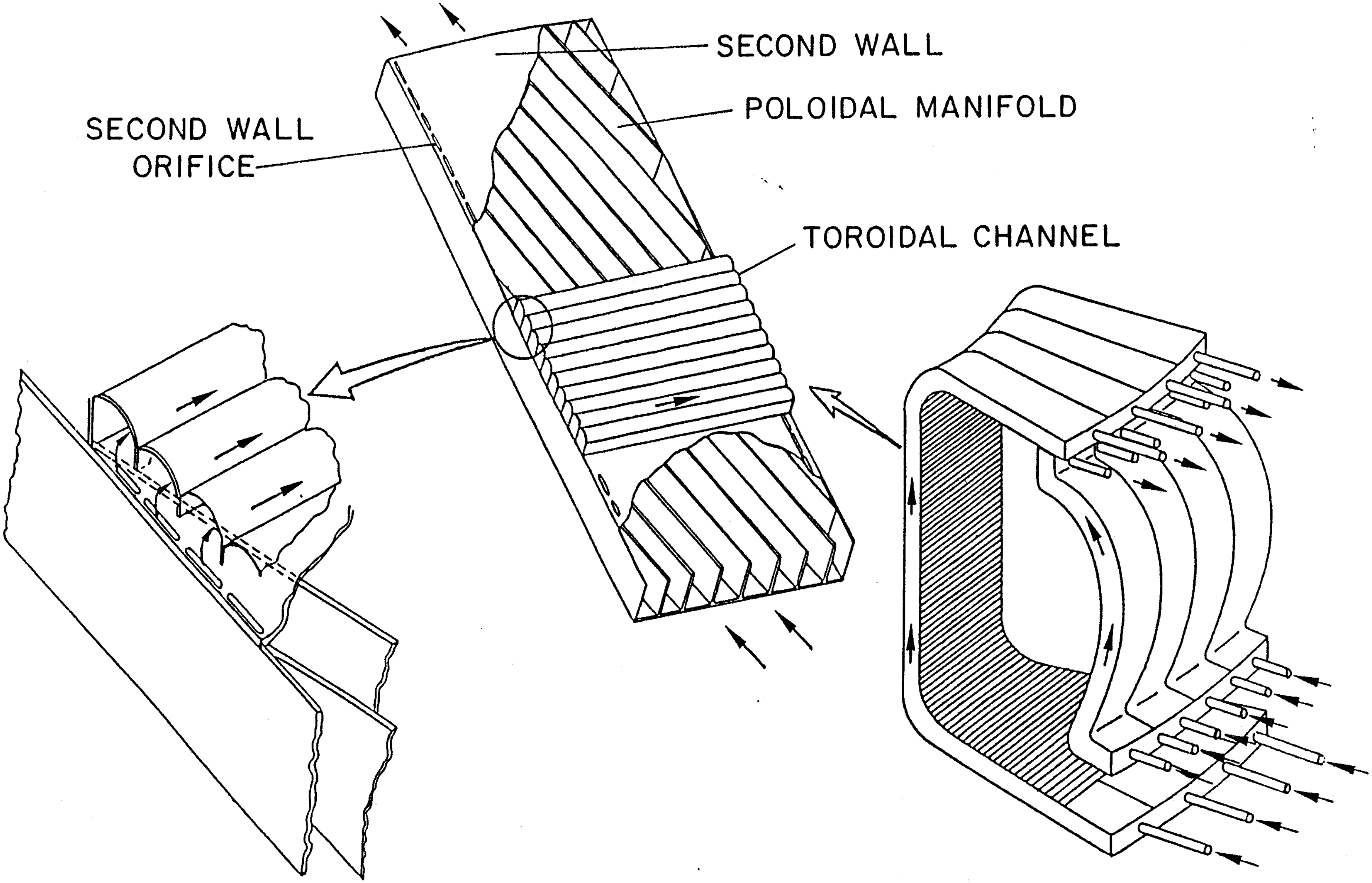
Tritium Fuel Self Sufficiency



Critical areas :

- Tritium burnup in plasma
- Neutronics data, methods, modelling
- Tritium inventory in blankets
- Tritium processing

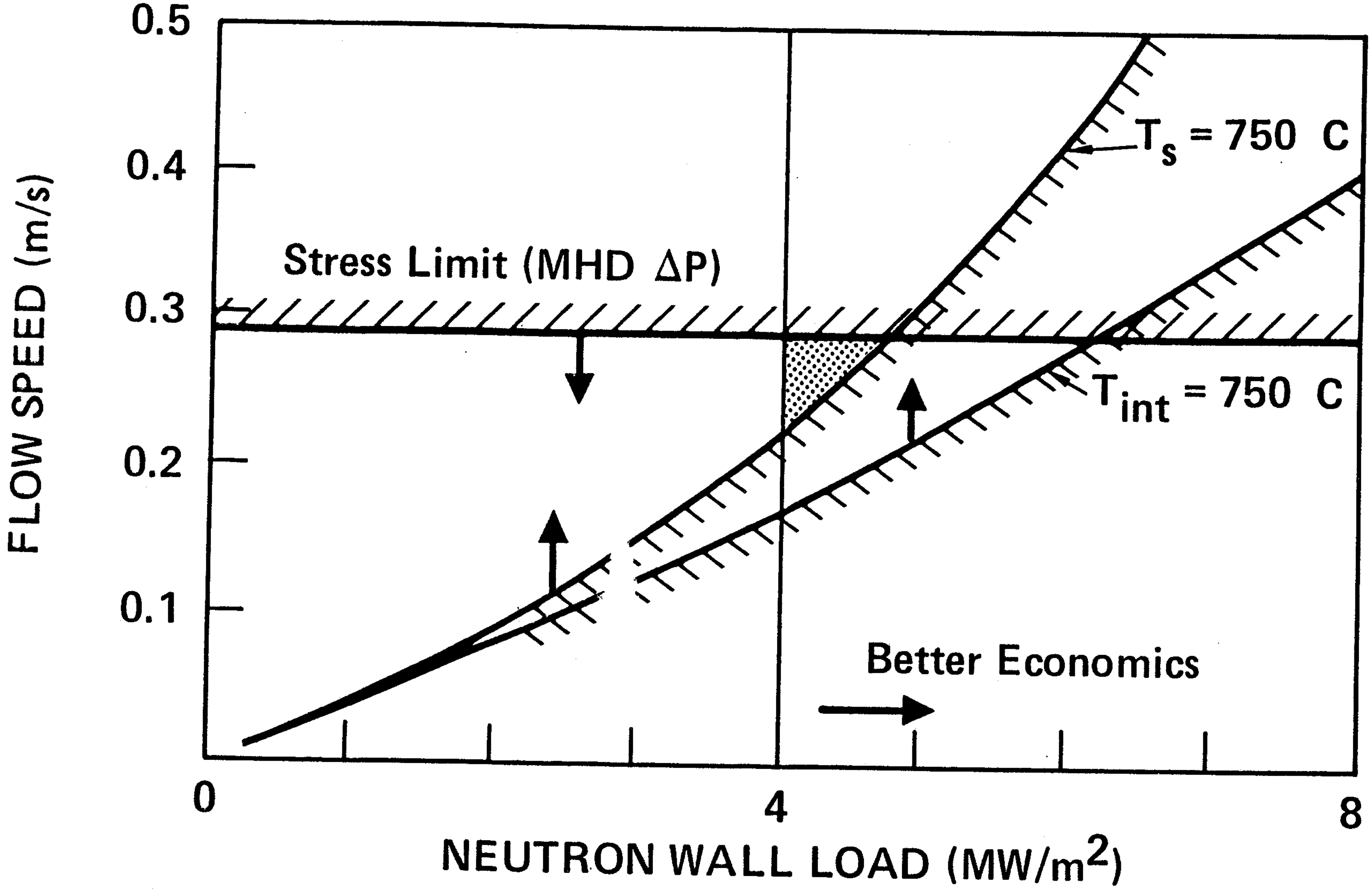
Li/Li/V BLANKET

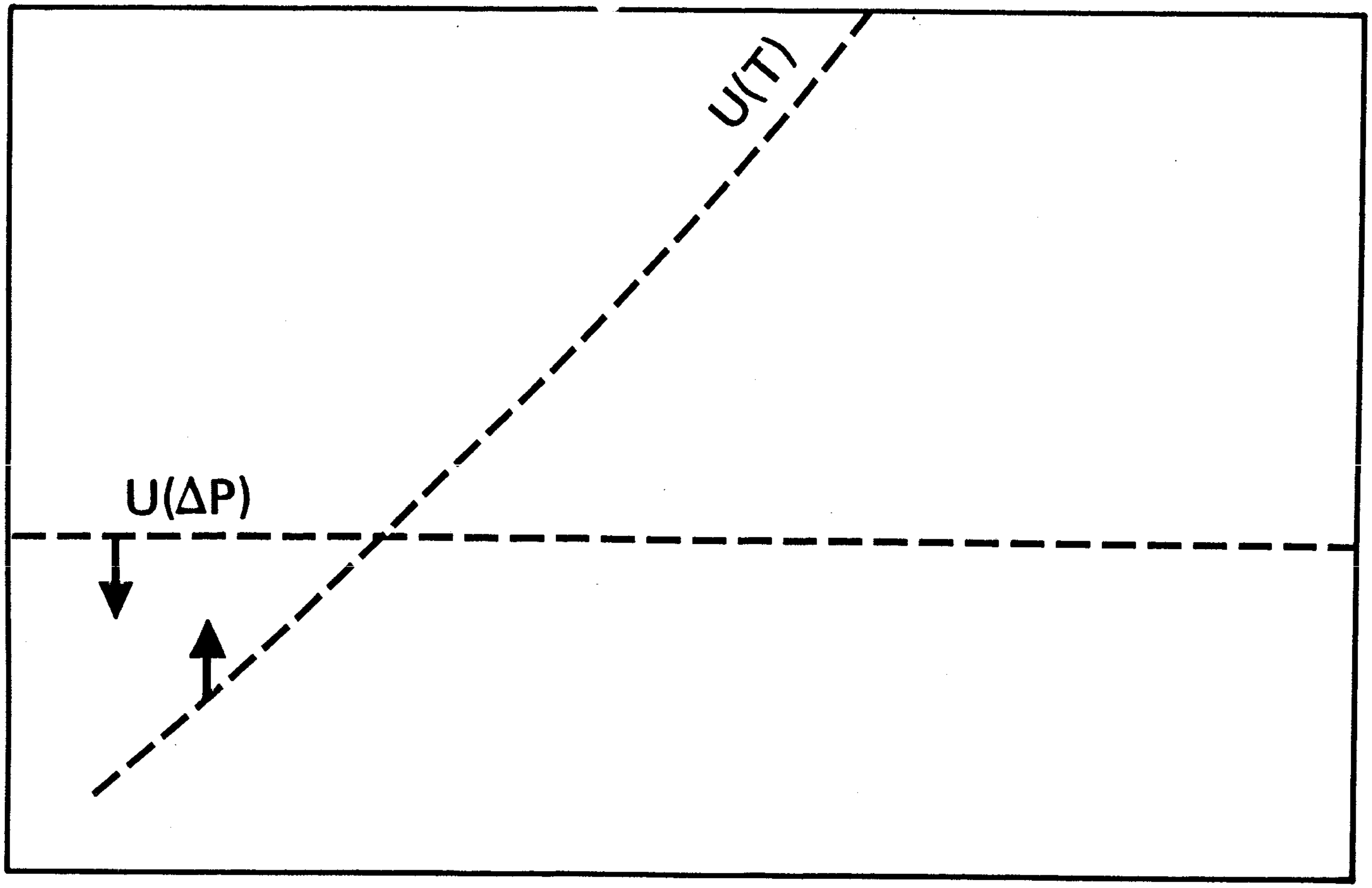


Generic Liquid Metal Blanket Issues

- Tritium Self-sufficency
- Magnetohydrodynamic (MHD) Effects
  —Fluid Flow (including pressure drop)
  —Heat Transfer
- Material Interactions (e.g., Corrosion)
- Structural Response in the Fusion Environment
  —Irradiation Effects on Material Properties
  —Response to Complex Loading Conditions
  —Failure Modes
- Tritium Recovery and Control

▨ Design Window Is Narrow For Best Liquid Metal Blanket (Li/V)





U(T): Any of:
T_s = 650 C
T_{int} = 550 C
h_m = 0.7h

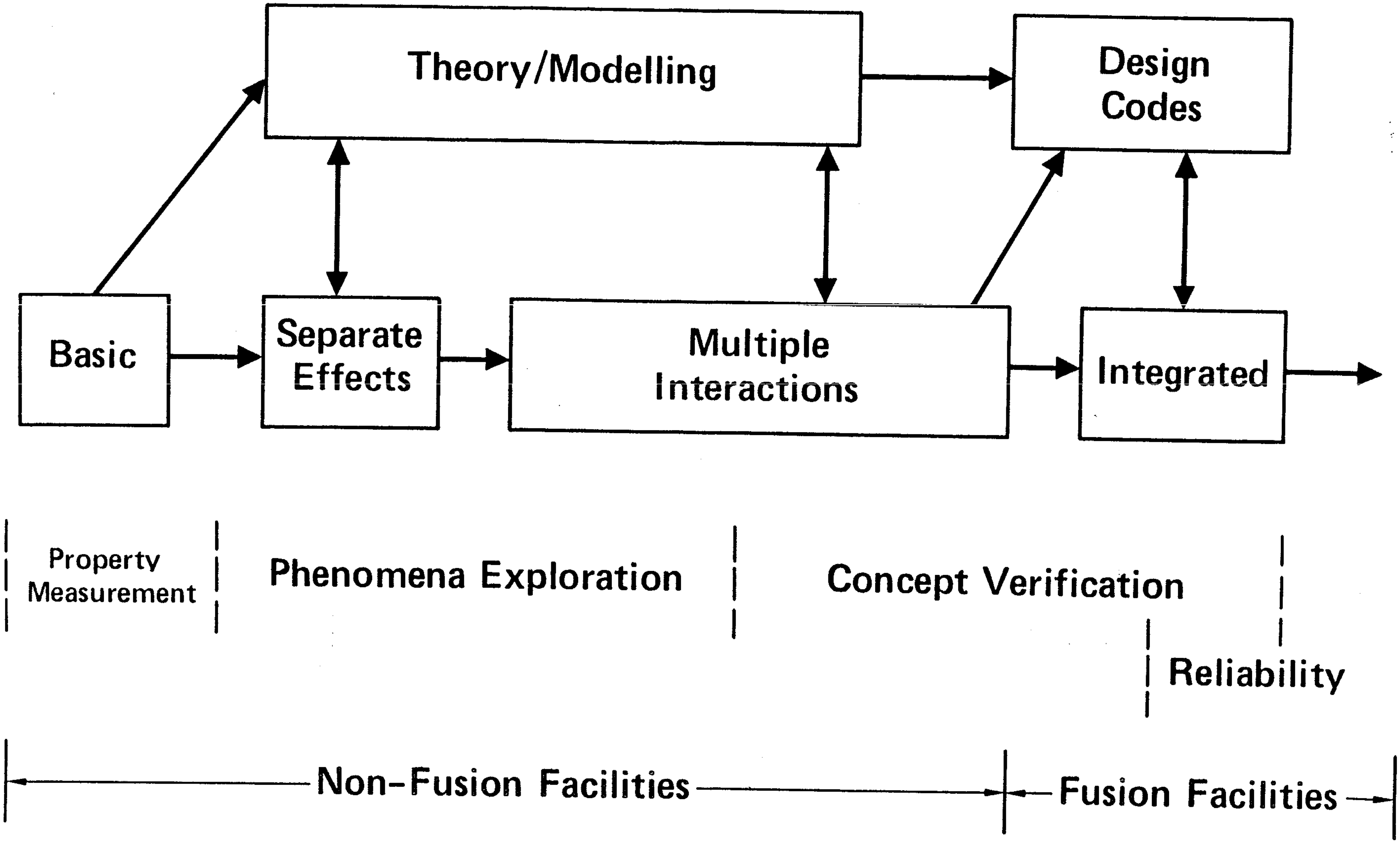
Uncertainties in MHD, Corrosion, Heat Transfer, Radiation Effects Represent Major Issues

OBJECTIVES OF U.S. FUSION NUCLEAR TECHNOLOGY PROGRAM

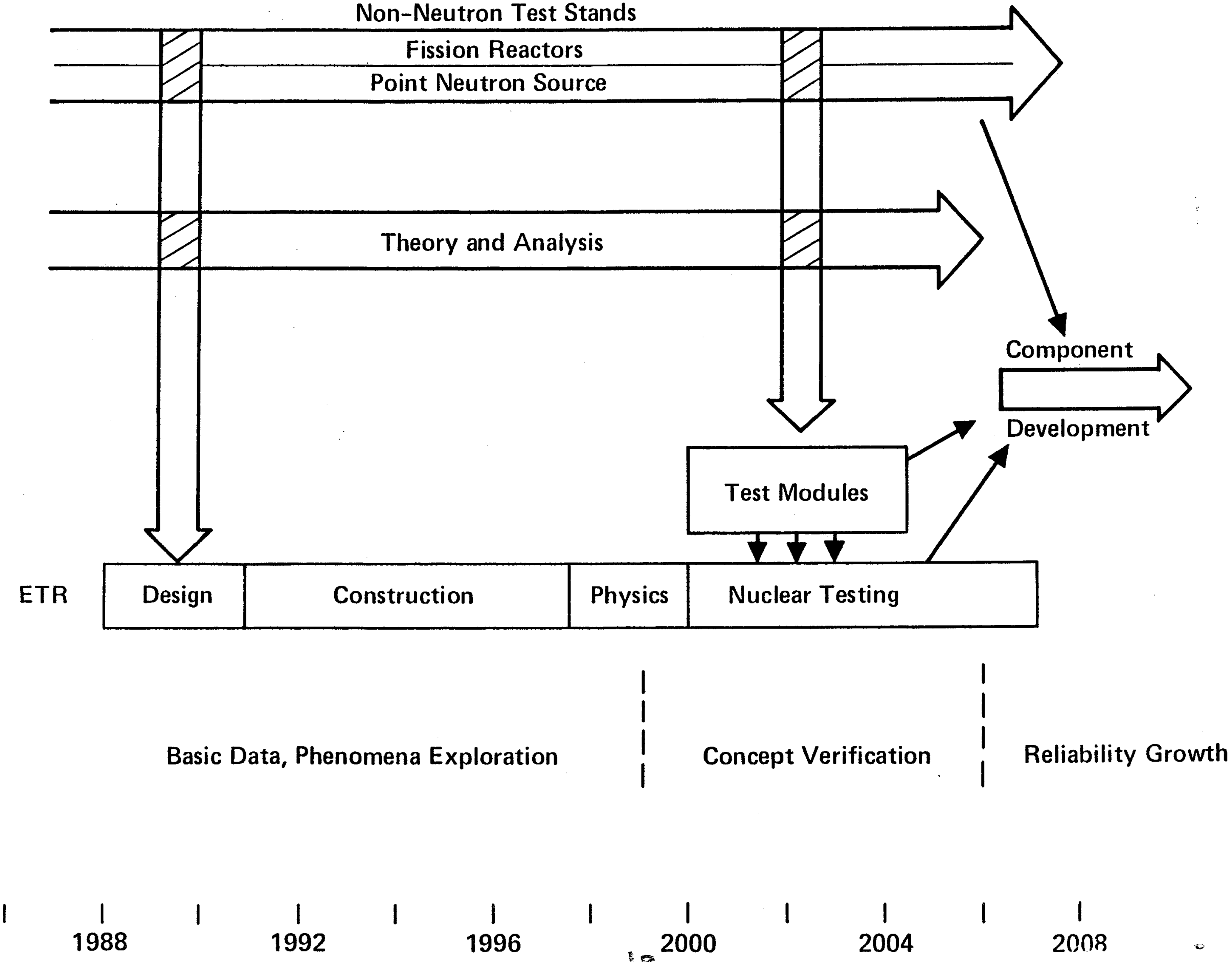
- DEVELOP NUCLEAR COMPONENTS FOR NEAR-TERM FUSION DEVICES (CIT AND ETR)

- IDENTIFY KEY ISSUES, DEVELOP TECHNICAL SOLUTIONS AND OBTAIN ENGINEERING DATA BASE FOR EVALUATING POTENTIALLY ATTRACTIVE CONCEPTS

- DEVELOP ATTRACTIVE NUCLEAR COMPONENTS FOR COMPETITIVE COMMERCIAL FUSION REACTORS


Theory/Modelling
Design Codes
Basic
Separate Effects
Multiple Interactions
Integrated
Property Measurement
Phenomena Exploration
Concept Verification
Reliability
Non-Fusion Facilities
Fusion Facilities

Framework For Fusion Nuclear Technology Development



Non-Neutron Test Stands

Fission Reactors

Point Neutron Source

Theory and Analysis

Component Development

Test Modules

ETR

Design

Construction

Physics

Nuclear Testing

Basic Data, Phenomena Exploration

Concept Verification

Reliability Growth

1988

1992

1996

2000

2004

2008

FNT R&D FRAMEWORK

- NON-FUSION TESTING (+ MODEL DEVELOPMENT)

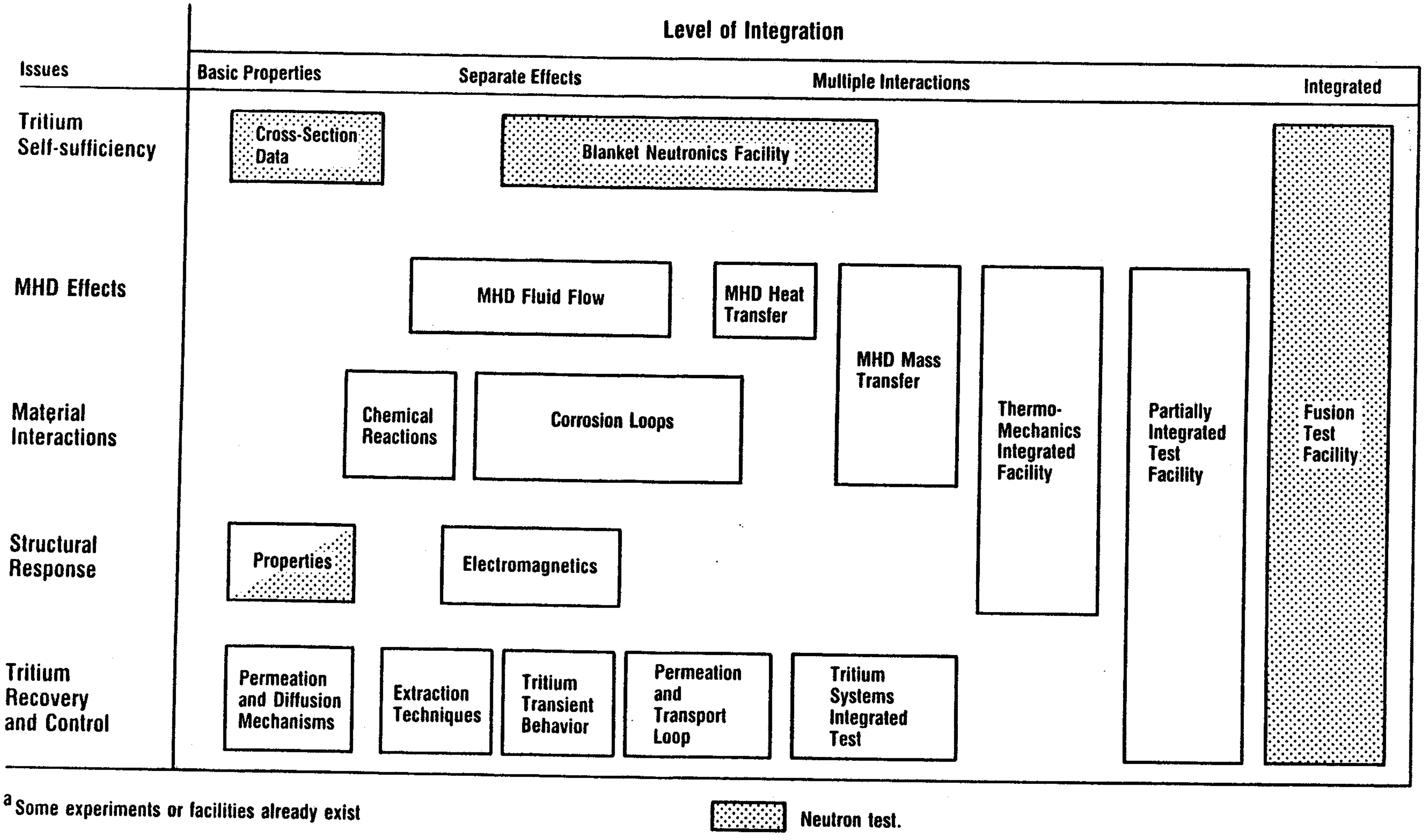
  NON-NEUTRON TEST STANDS
  FISSION REACTORS
  14 MEV NEUTRON SOURCES

  - SUPPORT CONCEPTUAL DESIGN SCREENING AND EVOLUTION
  - INITIAL VALIDATION OF THEORY AND MODELS
  - PROVIDE DATA FOR DESIGN, CONSTRUCTION AND OPERATION OF TEST ELEMENTS AND MODULES IN ETR

- FUSION TESTING

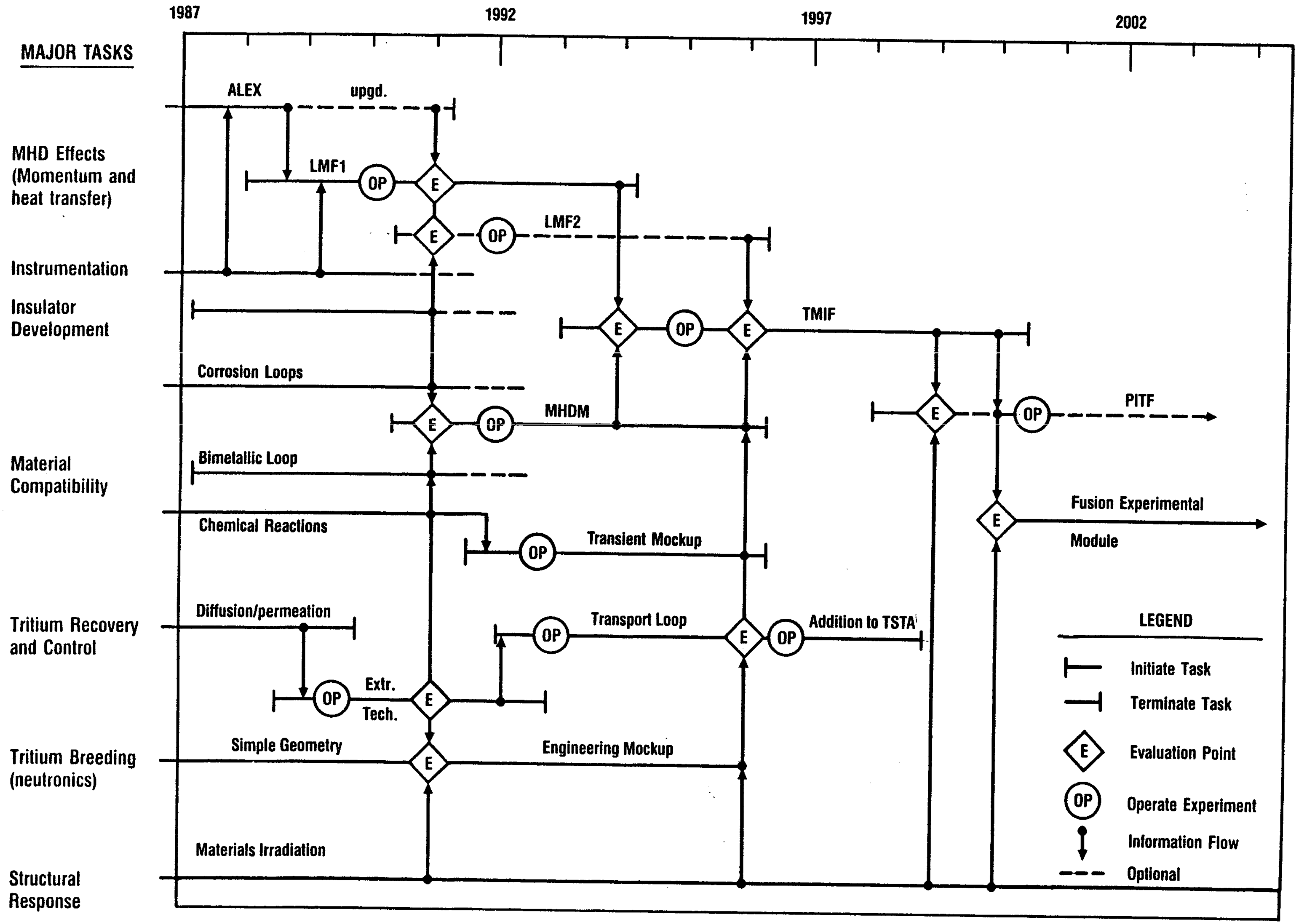
  - VERIFY THEORY/MODELS, DESIGN CODES
  - DATA FOR CONCEPT SELECTION
  - DEMONSTRATE PERFORMANCE LEVEL EXTRAPOLATABLE TO REACTOR
  - DEMONSTRATE ADEQUATE LEVEL OF RELIABILITY

TYPES OF EXPERIMENTS AND FACILITIES FOR LIQUID METAL BLANKETS[a]

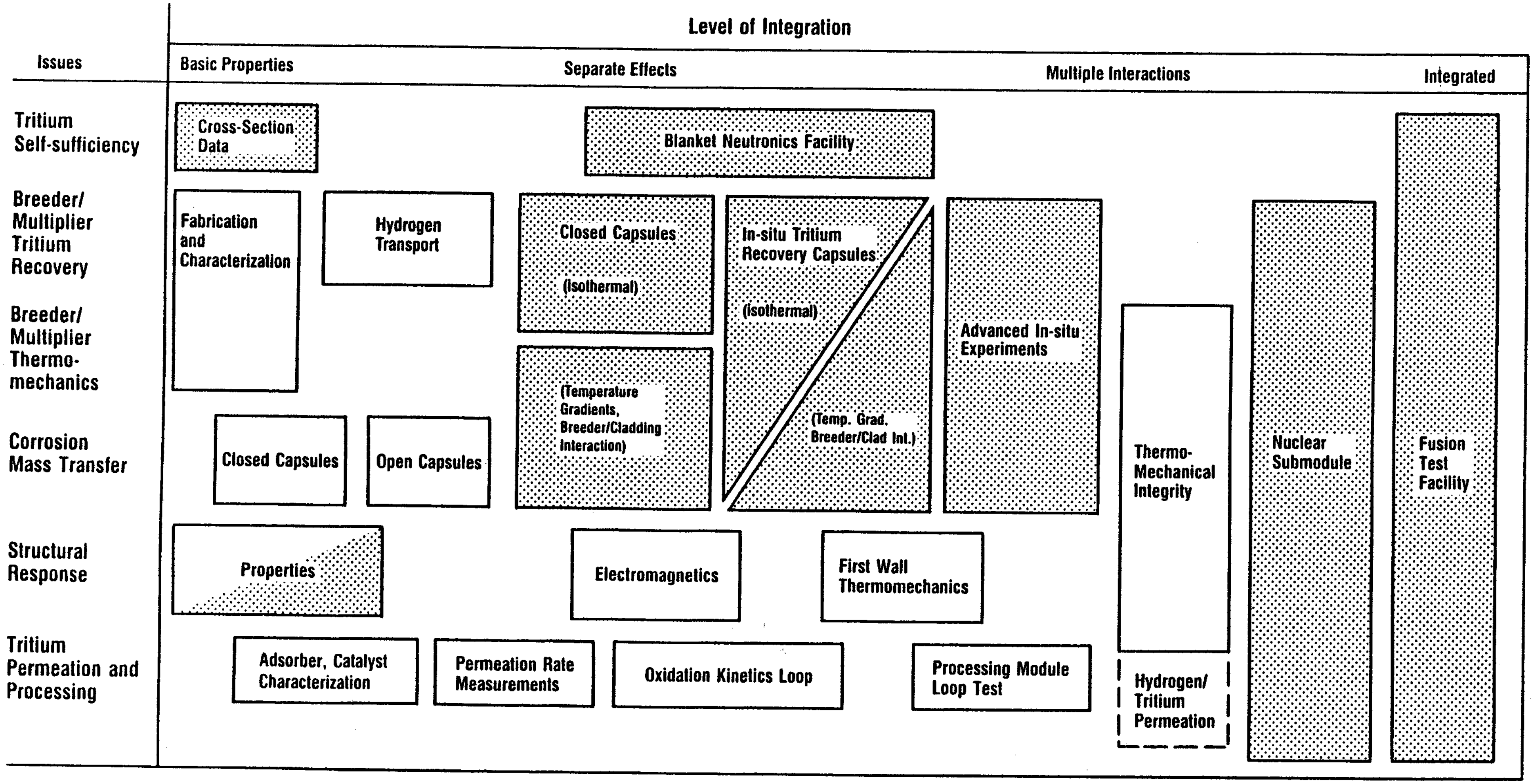


[a] Some experiments or facilities already exist

LIQUID BREEDER BLANKET TEST PLAN



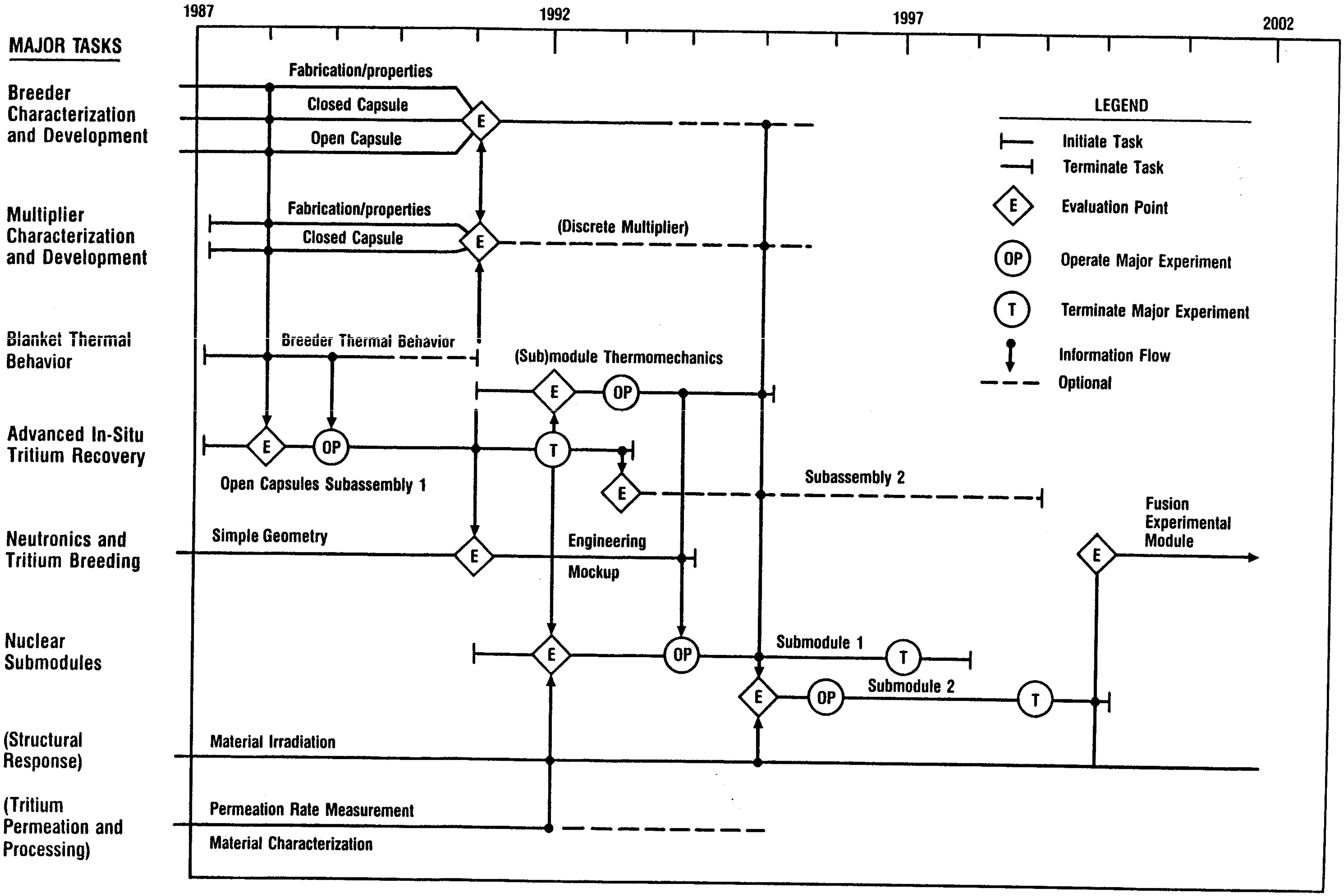
TYPES OF EXPERIMENTS AND FACILITIES FOR SOLID BREEDER BLANKETS[a]



[a] Some Experiments and Facilities Exist

▨ Neutron Test

SOLID BREEDER BLANKET TEST PLAN



Features and Objectives of Major Liquid Breeder Experiments

	ALEX	Magnetic Transport Phenomena Facilities		TMIF	PITF
		LMF	MHDM		
Features of Experiments	• Simple Geometry of a channel • NaK	• Basic elements of relevant geometry	• Basic elements of relevant geometry • Relevant material combinations • Transport loop • Relevant T, ΔT, impurities, V • Long operating time per experiment	• Actual materials and geometry • Transport loop • Relevant environmental and operating conditions	• Prototypic blanket module • Transport loop • Prototypic environmental and operating conditions
	• Measure velocity profile, electric potential, pressure drop	• Measure V and T profiles; pressure drop, temperature, electric potential	• Measure dissolution and deposition rates	• Measure integral quantities (ΔP, T, corrosion and deposition rates)	• Measure integral quantities
Objectives	• Develop and test velocity profile instrumentation in NaK environment • Validate MHD in simple geometry (basic heat transfer data may be possible in upgrade	• Develop and test instrumentation • Validate MHD heat transfer • Design data (ΔP, T) for configuration screening • Explore techniques to reduce ΔP and enhance heat transfer	• Develop and test instrumentation in relevant environment • Design data on MHD heat and mass transfer • Verify techniques to reduce corrosion and corrosion effects	• Design data for blanket test module • Confirm and refine configurations	• Engineering design data • Reliability data in non-fusion environment

Table 8. Characteristics of Major Liquid Breeder Experiments

Characteristic	ALEX[a]	Magnetic Transport Phenomena Facilities		TMIF[d]	PITF[e]
		LMF[b]	MHDM[c]		
Fluid	NaK (100°C)	NaK	actual materials	actual materials	actual materials
Testing volume (m x m x m)	1.83 x 0.76 x 0.15 (0.21 m^3)	3 x 1 x 0.5 (1.5 m^3)		3 x 1 x 0.5	3 x 1 x 0.5
Magnetic Field	2 T	4-6 T		4-6 T	4-6 T
Configuration	simple geometry	elements of complex geometry		submodule	prototypic

[a] Exists (ANL)

[b] Liquid Metal Flow Facility

[c] MHD Mass Transfer Facility

[d] ThermoMechanical Integration Facility

[e] Partially Integrated Test Facility

Representative Costs of Key Liquid Breeder Blanket Facilities[a]

Item	Capital Cost (M$)	Operating Cost (M$/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
Corrosion Loops	6-10	1.6	8-12	12-20
Tritium extraction test (2)	2-3	0.4	3-4	3-5
Tritium transport loop test	6-8	0.6	5-7	9-12
Partially Integrated Test Facility (PITF)	estimate not available			
Thermomechanical Integrated Test Facility (TMIF)	20-25	2.0-3.0	8-10	35-60
Analysis and model development	0	2.0-4.0	15	30-60

[a] In 1985 constant dollars

Representative Costs of Major Solid Breeder Tasks[a]

Task	Capital cost (M$)	Operating cost (M$/yr)	Duration (years)	Total cost (M$)
Solid Breeder Characterization and Development (Fabrication, properties, closed/open capsule irradiations)	5-7	5-8	5	30-50
Multiplier Characterization and Development (Fabrication, properties, closed capsule irradiations)	1-2	1-2	5	6-12
Blanket Thermal Behavior				
A. Breeder thermal behavior	0.8-1.5	0.8-1.5	3-5	3-8
B. Non-neutron (sub)module thermomechanics	3-8	0.8	4	5-10
Neutronics and Tritium Breeding				
A. Simple geometry	3-6	0.8-1.5	5	7-14
B. Engineering mockup	4-7	0.8-1.5	3	6-12
Advanced In-Situ Recovery (Two sequential subassemblies with multiple open capsules)	3-5 each	0.8 each	6 each	12-16
Nuclear submodules (Two parallel submodules)	5-7 each	1-1.5 each	7 each	20-30
Analysis and Model Development	0	2-3	15	30-45

[a] 1985 constant dollars (neutron charges not included)

CURRENT FNT ACTIVITIES

U.S. PROGRAM

- THE U.S. PROGRAM IS CHARACTERIZED BY A NUMBER OF RELATIVELY SMALL ACTIVITIES THAT ARE FOCUSED ON CRITICAL ISSUES AND MAKING EXCELLENT TECHNICAL PROGRESS
- NEW INITIATIVES ARE NEEDED IN THE NEAR TERM
  - TO ADDRESS CRITICAL TECHNICAL NEEDS
  - TO MAINTAIN U.S. COMPETITIVENESS

INTERNATIONAL PROGRAM

- FNT PROGRAMS HAVE SUBSTANTIALLY EXPANDED OVER THE PAST 3 YEARS

RESOURCES

EC ~ 3 x U.S.
JAPAN (JAERI + UNIV.) ~ U.S.
CANADA ~ 0.7 x U.S.

INTERNATIONAL COOPERATION ON FNT

- INTERNATIONAL COOPERATION IS RECOGNIZED AS AN IMPORTANT MECHANISM FOR MAXIMIZING PROGRESS IN FUSION NUCLEAR TECHNOLOGY
  - OPPORTUNITY: MANY AREAS OF FNT R&D ARE OF COMMON INTEREST TO ALL COUNTRIES
  - NECESSITY: SUBSTANTIAL RESOURCES ARE REQUIRED TO RESOLVE FNT ISSUES
  - EFFECTIVENESS: MANY SMALL-SCALE AND USER TYPE FACILITIES PERMIT EFFECTIVE AND EQUITABLE COST/BENEFIT SHARING PROGRAMS

- EXISTING ARRANGEMENTS

E.G.,	FUSION NEUTRONICS	US/JAERI
	SOLID BREEDER EXPERIMENTS	IEA
	TRITIUM PROCESSING	US/J/EC
	LIQUID METAL MHD	US/EC

- RECENT EFFORTS

AIMED AT SUBSTANTIAL AND EFFECTIVE INTERNATIONAL COOPERATION

- TWP -IEA -US/USSR
- EXPLORATORY DISCUSSIONS

TABLE 7-I. DISTRIBUTION OF INTERNATIONAL EFFORT AMONG THE VARIOUS BLANKET CONCEPTS
(H = Strong Interest, L = Lesser Interest)

	Breeder/coolant/structure/multiplier	USSR[a]	USA[d]	Japan[d]	EC[d]
Self-cooled liquid breeders	Li/Li/V		H	L	
	Li/Li/FS		L[b]		
	Li/Li/AS				
	Li/Li/AS/U-Be	c			
	LiPb/LiPb/V		L[b]/H		
	LiPb/LiPb/AS				
	LiPb/LiPb/FS				L
	Flibe/Flibe/V		H		
Quasi-stagnant liquid breeders	Li/He/FS		L/H		
	Li/He/Mo			H	
	Li/He/FS/U-Pb	L			
	LiPb/H_2O/AS-FS				H
	LiPb/H_2O/AS/U-Pb	H			
	LiPb/He/FS/Be		H[b]		
	LiPb/PbBi/AS/U-Pb	H			
	Flibe/He/FS/Be		H		
Li_2O blankets	Li_2O/He/FS		L/H		
	Li_2O/He/FS-V/Be		L		
	Li_2O/He/Mo/Be			H	
	Li_2O/He/FS/U-Pb	L			
	Li_2O/H_2O/AS/Be			L	
	Li_2O/H_2O/AS/U-Pb	L[b]			
Ternary ceramics	$LiAlO_2$/He/FS/Be		L/H		H
	$LiAlO_2$/He/Mo/Be			L	
	$LiAlO_2$/He/FS/U-Pb	L			
	$LiAlO_2$/H_2O/FS/Be		H		
	$LiAlO_2$/H_2O/U-Pb	L[b]			
	$LiAlO_2$/NS/FS/Be		L		

[a] Hybrid blankets include ^{238}U as neutron multiplier.

[b] Considered for tandem mirror reactor.

[c] Considered for inertial confinement reactor.

[d] Does not include hybrid designs.

TABLE 7-III. KEY PARAMETERS OF NEW MHD TEST FACILITIES

Facility, location	Start of operation	Maximum magnetic field (T)	Testing volume (m × m × m)	LM	Flow rate, ($L \cdot s^{-1}$)	Maximum MHD parameters, (M, N)
Sodium loop, Inst. Phys., Riga, USSR	1982	2	0.25[a] × 0.25	Na	15	10^4, 5×10^4
ALEX, USA	1985	2	1.5 × 0.8 × 0.15	NaK	19	10^4, 10^4
MALICE, Belgium	1985	2	1 × 0.1 × 0.1	Li		

[a] Diameter of a solenoid bore.

TABLE 7-IV. LITHIUM AND LITHIUM-LEAD CORROSION LOOPS

Laboratory	Li		$Li_{17}Pb_{83}$	
	Thermal convection	Forced circulation	Thermal convection	Forced circulation
MOL (Belgium)	X	X	X	
CEA (France)			X	
Kurchatov Efremov (USSR)		X		
ANL ORNL (USA)	X	X	X	X
KfK (FRG)		X		X

TABLE 7-V. CORROSION RATES IN $Li_{17}Pb_{83}$

Laboratory	Alloy	Temperature (°C)	Duration (h)	Ferrite thickness (μm)	Corrosion rate ($\mu m \cdot a^{-1}$)
ANL	316 SS	450	3000	32	90
CEA		450	3000	33	–
MOL		450	1000	35	83
CEA		400	3000	15	–
MOL			1000	8	13
ANL	Fe-9Cr	450	3000		9

TABLE 7-VII. COMPLETED AND ACTIVE SOLID BREEDER MATERIAL IRRADIATION EXPERIMENTS

Experiment	Ceramic	Grain size (μm)	Density (% TD)	Temperature (°C)	Li burnup (Max. at.%)	Reactor	Time frame
Closed capsule							
ORR (US)	Li_2O	<47	70	750, 850, 1000	0.05	ORR	–
TULIP (US)	Li_2O	50	87	600	3	EBR-II	84
FUBR-1A (US)	Li_2O	6	85	500, 700, 900	1.5	EBR-II	84/85
	$LiAlO_2$	<1	85, 95	500, 700, 900	3		84/85
	Li_4SiO_4	2	85	500, 700, 900	2		84/85
	Li_2ZrO_3	2	85	500, 700, 900	2		84/85
FUBR-1B (US)	Li_2O	<5	60, 80	500, 700, 900	5	EBR-II	85/89
	Li_2O	<5	80	500–700/1000			
	$LiAlO_2$	<5–10	80	500, 700, 900	9		85/89
	(sphere-pac)		80	500–700/1000			
	Li_4SiO_4	<5	80	400–500	9		85/89
	Li_8ZrO_6	<5	80	600–700	7		85/89
	Li_2ZrO_3	<5	85	520–620	7		85/89
ALICE (France)	$LiAlO_2$	0.35–13	71–84	400, 600	–	OSIRIS	85/86
DELICE (FRG)	Li_2SiO_3 (Li_4SiO_4)	–	65, 85, 95	400, 600, 700	<0.02	OSIRIS	85/86
ORDALIA (Italy)	$LiAlO_2$	0.4–2.0–10	80	500, 700	–	OSIRIS	86/87
EXOTIC (Neth./UK/ Belgium)	Li_2SiO_3	–	80	400, 600	–	HFR	85/86
	Li_2O	–	–		–		85/86
	$LiAlO_2$	30	80		–		85/86
	Li_2ZrO_3	–	–		–		85/86
CREATE (Canada)	$LiAlO_2$	<1	80, 90	100	–	NRU	85/86
In-situ tritium recovery							
TRIO (US)	$LiAlO_2$	0.2 (50 μm particles, 0.9 cm thick annular pellet)	65	400, ..., 700	0.2	ORR	84/85
VOM-15H (Japan)	Li_2O	<10	86	480, ..., 760	0.24		84
VOM 22/23 (Japan) (Japan)	Li_2O	– (1.1 cm pebbles)	–	400–900	0.04		–
	$LiAlO_2$	– (1.1 cm pebbles)	–	400–900	0.1		–
LILA (France)	$LiAlO_2$	1–30 (1 cm diameter pellet)	78	375–600	<0.02	SILOE	86
LISA (FRG, France)	$LiAlO_2$	0.4	78	450–730	–	SILOE	86
	Li_2SiO_3	30–80	86–93	450–730	–		
	Li_4SiO_4	26 (1 cm diameter pellet)	94	450–730	–		
EXOTIC (Neth./UK/ Belgium)	$LiAlO_2$	30 (1.4 cm diameter pellet)	80, 95	400, 600	<0.4	HFR	86
	Li_2SiO_3	– (1.4 cm diameter pellet)	50	400, 600	<0.4		86
TEQUILA (Italy)	$LiAlO_2$	0.4–2.0–10 (1 cm diameter pellet)	80	500, 700	–	SILOE	86/87
CRITIC (Canada)	Li_2O	60 (1 cm thick annular pellet)	90	400–900	0.15	NRU	86

TABLE 7-VIII. BLANKET TRITIUM EXTRACTION METHODS AND INTERNATIONAL INTEREST

Carrier fluid	Tritium form		Extraction method[a]	USSR	USA	Japan	Europe	Canada
	T_2/HT	T_2O/HTO						
LiPb	X		Vacuum degassing	X				
	X		*Extraction with countercurrent He flow*	X	X		X	
	X		Permeation combined with catalytic oxidation				X	
Li	X		Absorption with solid getters					
	X		*Extraction with molten salt*		X			
He (purge)	X	X[b]	*Absorption with solid getters*	X				
	X[c]	X	*Absorption with molecular sieves*		X			X
	X[c]	X	Freezing out in cold traps				X	
He (coolant)	X	X[b]	*Absorption with molecular sieves*	X	X	X	X	X
H_2O		X	Vapour phase catalytic exchange					
		X	Liquid phase catalytic exchange		X			X
		X	Electrolysis				X	

[a] Preferred method in italics.
[b] Additional process needed to decompose T_2O, HTO.
[c] Additional process needed to oxidize T_2, HT.

MAJOR NEAR-TERM NEEDS (NEXT ~ 3 YRS)

1. LIQUID METAL FLOW FACILITY (LMF1)

   FACILITY WITH CAPABILITIES FOR EXPERIMENTS ON MHD FLUID FLOW, HEAT TRANSFER AND PRESSURE DROP IN RELEVANT GEOMETRY

2. ADVANCED SOLID BREEDER TRITIUM RECOVERY EXPERIMENT

   EXPERIMENTS IN FISSION REACTOR TO STUDY (IN-SITU) TRITIUM RECOVERY WITH LOCAL REACTOR-RELEVANT CONDITIONS

3. ENGINEERING TRITIUM BREEDING EXPERIMENTS

   EXTEND THE CAPABILITIES OF TRITIUM BREEDING EXPERIMENTS TO INCLUDE MORE PROTOTYPICAL NEUTRON SOURCE AND TEST SECTION GEOMETRY AND MATERIALS

OBJECTIVES OF LMF1

TESTING OF MHD FLUID FLOW, HEAT TRANSFER, AND PRESSURE DROP IN BASIC GEOMETRIC ELEMENTS OF THE BLANKET AND PLASMA-INTERACTIVE COMPONENTS

- MEASURE VELOCITY, PRESSURE, TEMPERATURE, AND ELECTRIC POTENTIAL DISTRIBUTIONS
- DEVELOP AND TEST INSTRUMENTATION IN NaK ENVIRONMENT
- VALIDATE MHD FLOW, PRESSURE, AND HEAT TRANSFER PREDICTIVE CAPABILITY FOR SEGMENTS OF BLANKET MODULES
- OBTAIN DESIGN DATA FOR SEGMENTS OF BLANKET MODULES
- EXPLORE TECHNIQUES TO REDUCE PRESSURE DROP AND ENHANCE HEAT TRANSFER

LMF FACILITY PARAMETERS

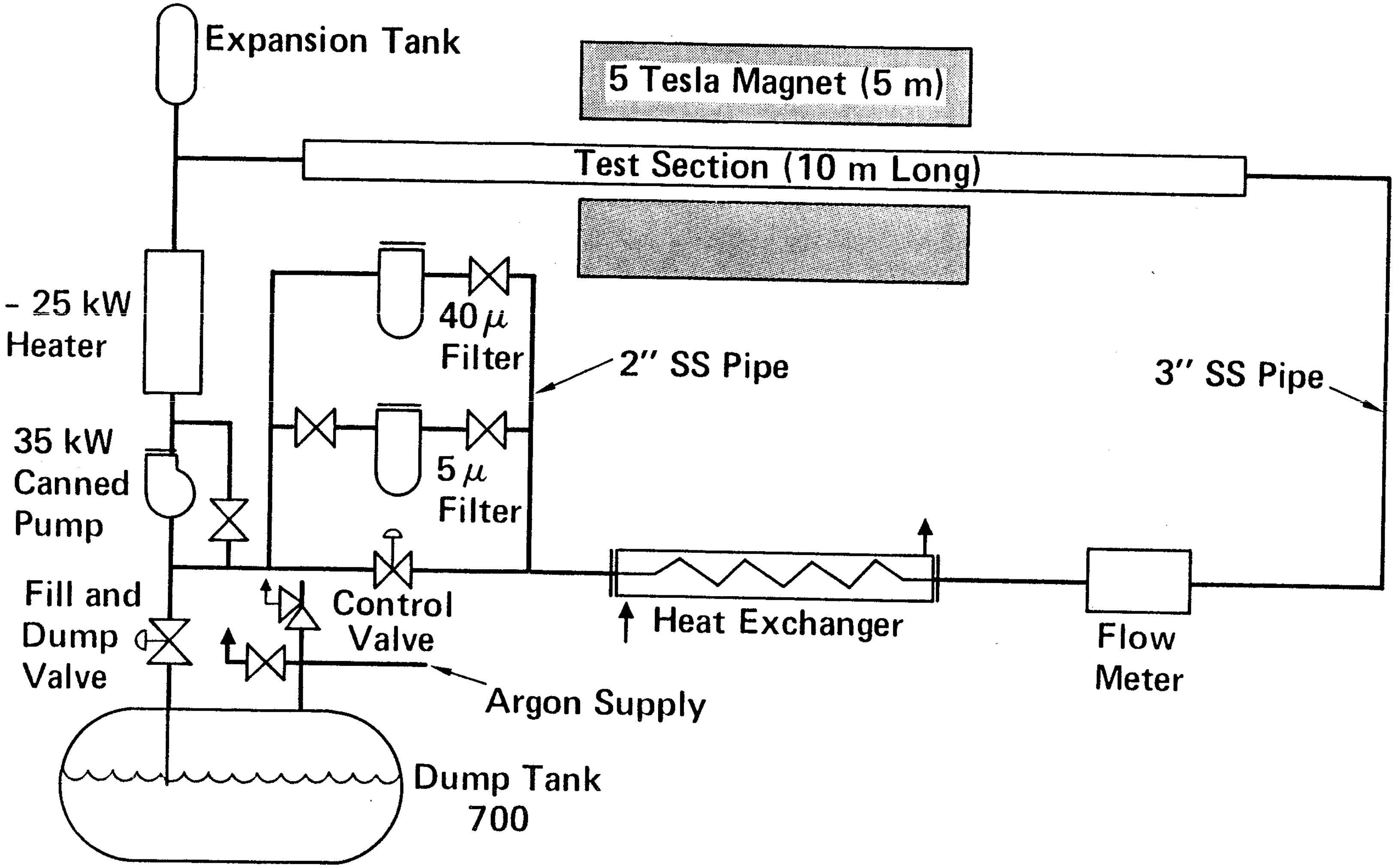
LOOP PARAMETERS

WORKING FLUID	NAK EUTECTIC
INVENTORY OF WORKING FLUID	700 LITERS
LOOP MATERIALS	PREDOMINATELY 300 SERIES S/S
VOLUMETRIC FLOW RATE THROUGH TEST ARTICLES	1-25 LITERS/S
PUMP OUTLET PRESSURE	1 MPA
PUMP OUTLET TEMPERATURE	< 100°C
TEST ARTICLE CONDITIONING TEMPERATURE (AT LOW PRESSURE AND FLOW RATE)	300°C
OVERALL LENGTH OF TEST ARTICLE (BETWEEN FLANGES FOR TEST SECTION REPLACEMENT)	~ 10 M
COST (EXCLUDING COST OF TEST ARTICLES)	$1 M

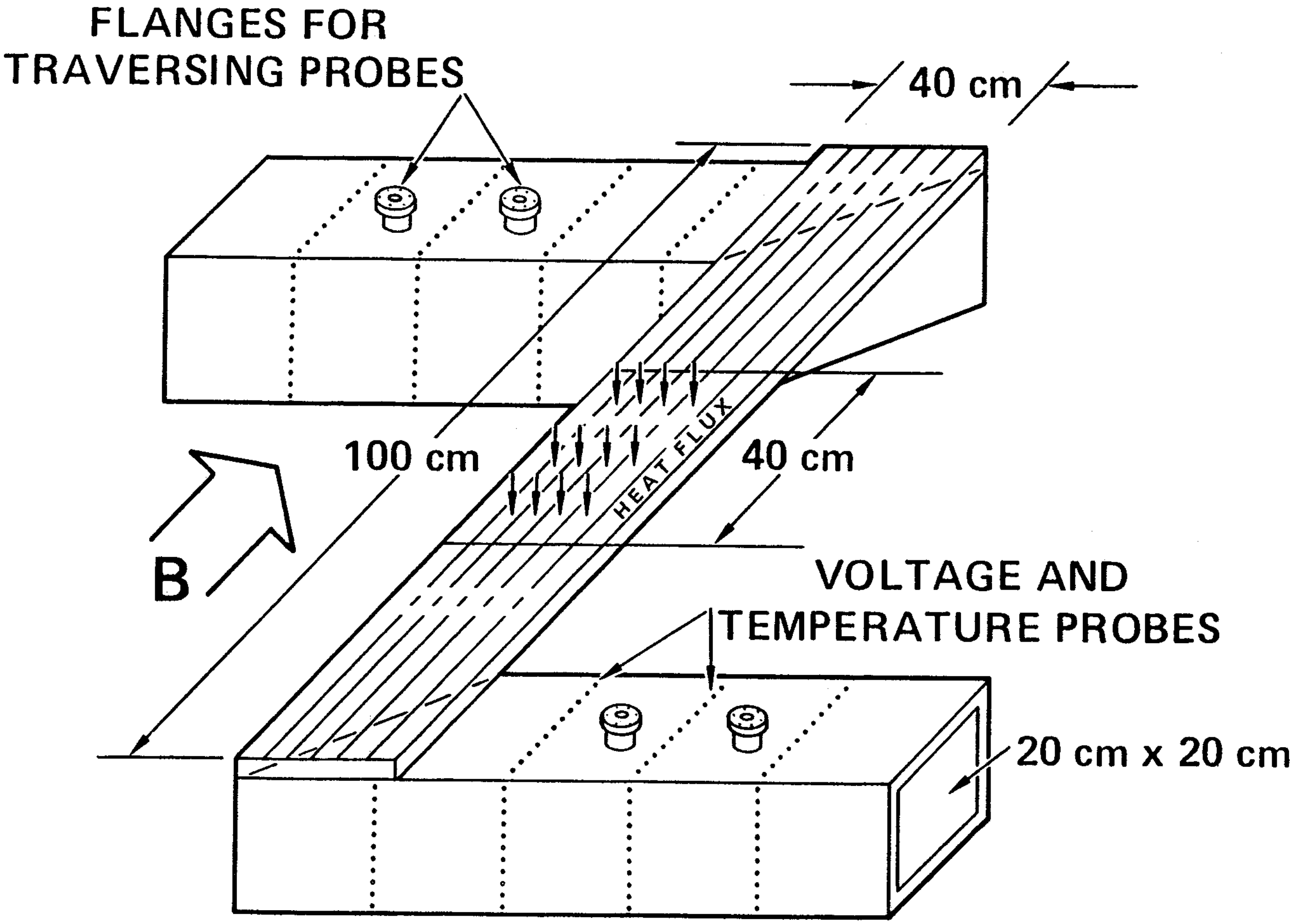
MAGNET PARAMETERS

PEAK FIELD	5 T
WARM BORE	1.2 M
UNIFORM FIELD VOLUME	1 M X 0.3 M X 3 M
FIELD UNIFORMITY	± 5%
MAGNET COST	$15 M

SCHEMATIC OF LMF LOOP



Example of a test section simulating the BCSS liquid-metal-cooled blanket design. Measurements of velocity and temperature profiles.



ADVANCED IN-SITU TRITIUM RECOVERY EXPERIMENTS FOR SOLID BREEDERS

FACILITIES: FISSION REACTORS

FAST, THERMAL: USA, EC, JAPAN

OBJECTIVE:

STUDY TRITIUM RECOVERY WITH LOCAL REACTOR-RELEVANT CONDITIONS

- MODERATE TO HIGH BURNUP
- TEMPERATURE GRADIENT
- PURGE FLOW
- BREEDER/CLAD/MECHANICAL AND CHEMICAL INTERACTIONS

EXPERIMENTS:

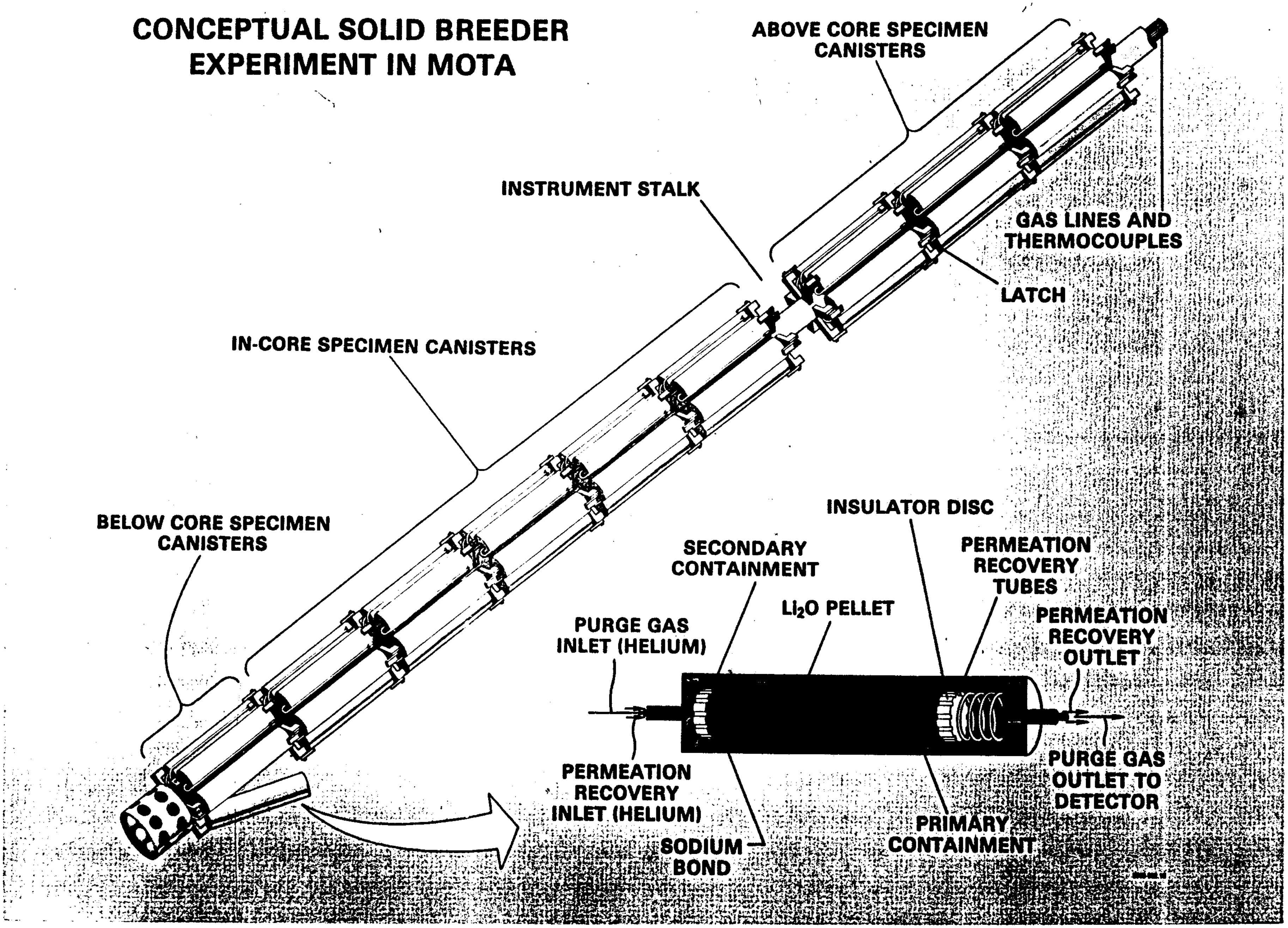
- KEY COMBINATIONS OF SOLID BREEDER MATERIALS AND NEUTRON MULTIPLIERS
- REPRESENTATIVE GEOMETRIES

COST:

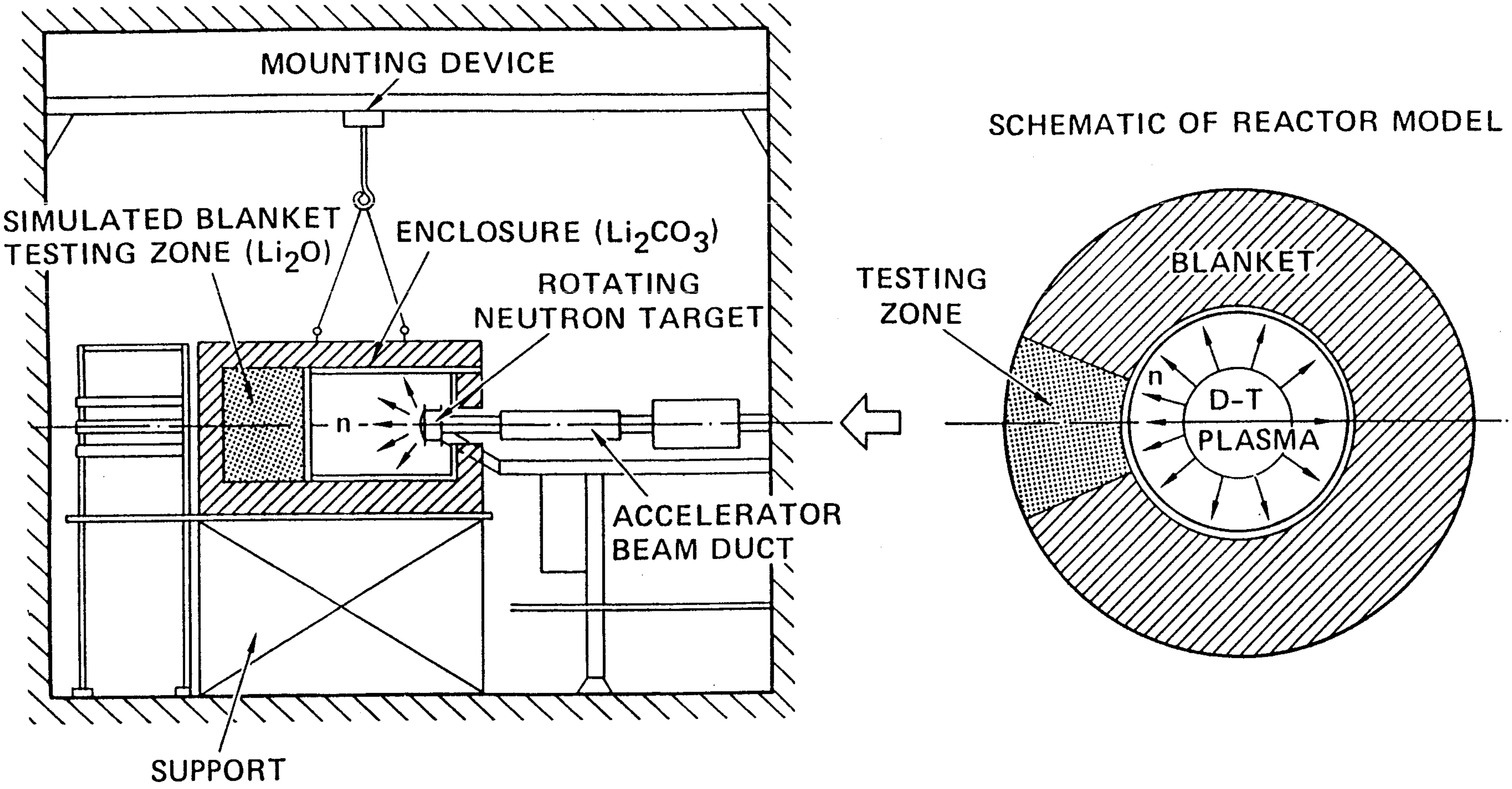
$3 M,

PLUS PIE AND TEST ELEMENT PREPARATION COSTS

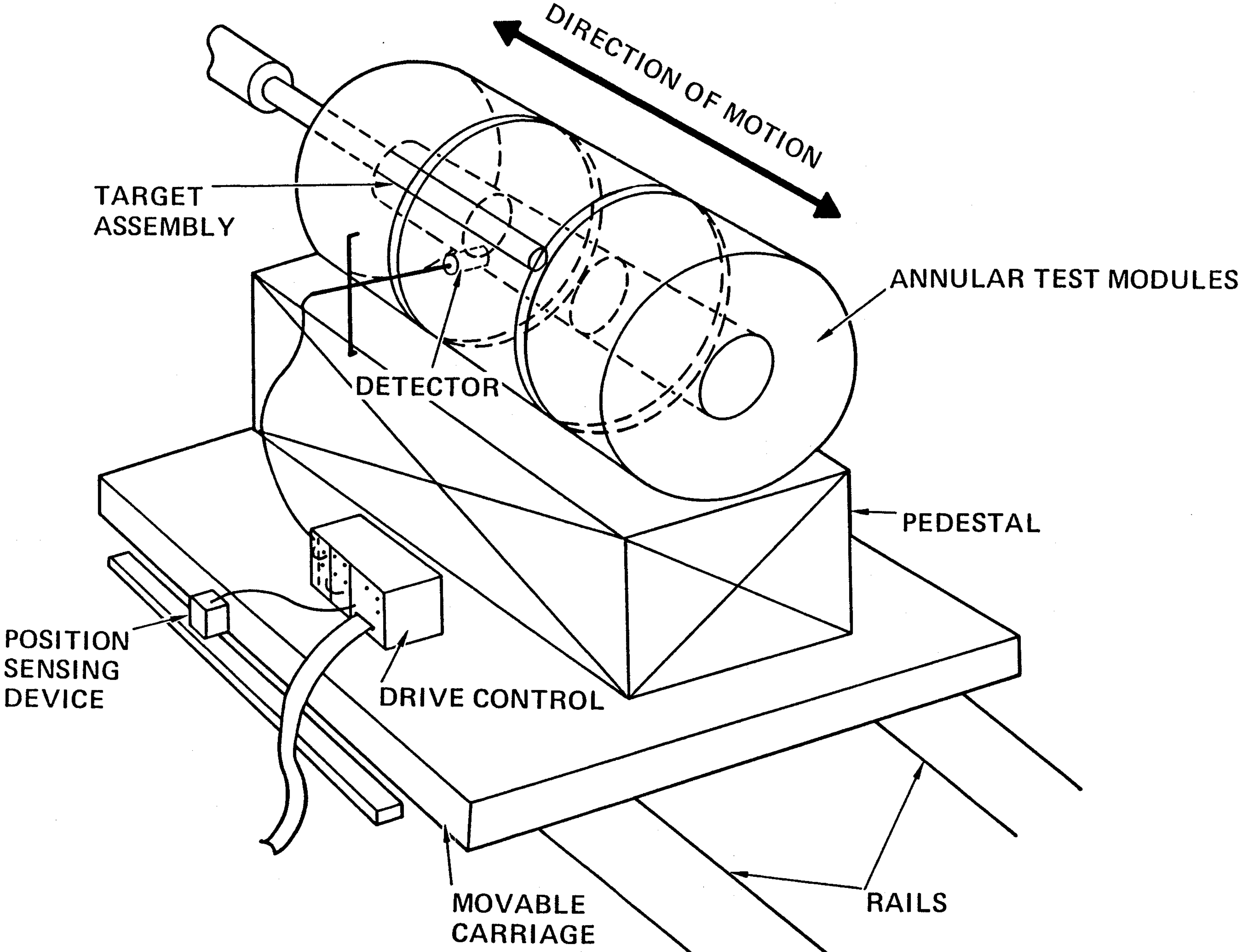
CONCEPTUAL SOLID BREEDER EXPERIMENT IN MOTA



EXPERIMENTAL SYSTEM FOR PHASE-2 OF US/JAERI PROGRAM ON BLANKET NEUTRONICS



ADVANCED LINE SOURCE FOR TRITIUM BREEDING EXPERIMENTS



Importance of ~~MOTIVATIONS FOR~~ FUSION NUCLEAR TECHNOLOGY PROGRAM

- RESOLVE SOME OF THE MOST CRITICAL UNRESOLVED FEASIBILITY ISSUES FOR FUSION

- SUBSTANTIALLY ENHANCE THE POTENTIAL COMPETITIVENESS OF FUSION REACTORS
  - ECONOMICS
  - SAFETY AND ENVIRONMENT

- SELECTION OF NUCLEAR CONCEPTS CAN SIGNIFICANTLY IMPACT PLASMA ENGINEERING ISSUES AND VICE VERSA

- NEAR-TERM FUSION DEVICES THAT BURN TRITIUM (e.g. ITER) WILL HAVE NEW CHALLENGING NUCLEAR ISSUES

  E.G, **BLANKET** TO PRODUCE TRITIUM

- ~~TIME SCALE FOR~~ FNT DEVELOPMENT ~~IS LONG~~ requires long lead time

DEVELOPMENT AND TECHNOLOGY
FY87 BUDGET DISTRIBUTION
($52.4M)