THERMAL ENERGY STORAGE EFFORT AT JPL

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OUTLINE OF THE PRESENTATION

- JPL INTEREST IN THERMAL ENERGY STORAGE
- IMMEDIATE APPLICATIONS
- METHODOLOGY FOR JPL EFFORT
- TASKS FOR JPL SUPPORT TO SLL
- JPL IN-HOUSE WORK
- PLANNED PROCUREMENTS
- SCHEDULE

JPL PARABOLIC DISH PROGRAM

OBJECTIVES

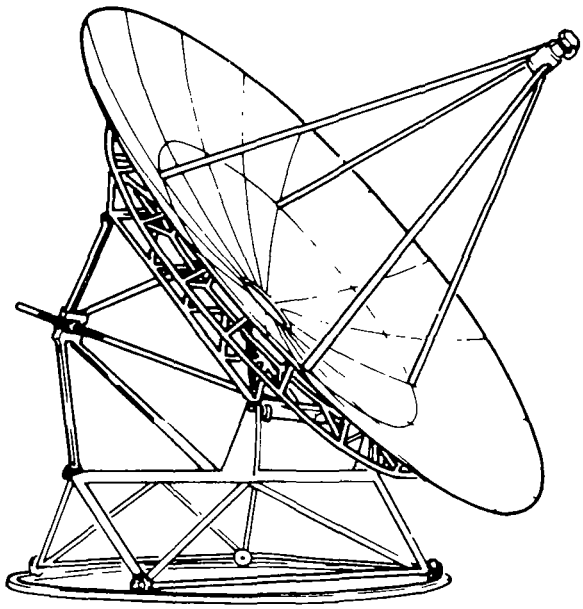
- TO ESTABLISH TECHNICAL, OPERATIONAL & ECONOMIC READINESS OF PARABOLIC DISH SYSTEMS FOR ELECTRIC AND THERMAL APPLICATIONS

- TO DEVELOP PARABOLIC DISH SYSTEMS TO THE POINT AT WHICH SUBSEQUENT COMMERCIALIZATION ACTIVITIES CAN LEAD TO SUCCESSFUL MARKET PENETRATION

JPL INTEREST IN THERMAL ENERGY STORAGE

- PROVIDE TECHNICAL SUPPORT TO THE THERMAL ENERGY STORAGE FOR SOLAR THERMAL APPLICATIONS (TESSTA) PROGRAM
- IDENTIFY CONCEPTS, ASSESS THEIR FEASIBILITY, AND DEVELOP ENGINEERING DESIGNS OF PARABOLIC DISH LATENT THERMAL ENERGY STORAGE ELEMENTS
- PLAN AND CONDUCT SUBSYSTEM RESEARCH EXPERIMENTS AT PARABOLIC DISH TEST SITE (PDTS, EDWARD) TO DEMONSTRATE THE READINESS OF THE LATENT HEAT ENERGY STORAGE
- IDENTIFY CONCEPTS AND ASSESS THEIR FEASIBILITY FOR ADVANCED, HIGH TEMPERATURE (1500-2800°F) THERMAL STORAGE

CURRENT APPLICATIONS



- SMALL COMMUNITY SOLAR THERMAL POWER EXPERIMENT (EE-1)
- ISOLATED LOAD EXPERIMENTS SERIES (EE-2 ETC)
- THERMAL APPLICATIONS EXPERIMENTS SERIES (EE-3)
- ADVANCED DISH STIRLING

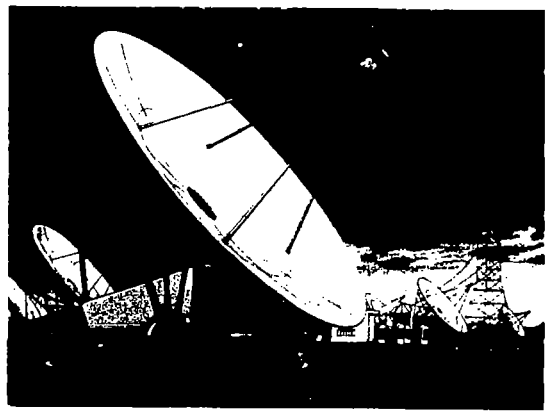
ENERGY STORAGE REQUIRED TO BUFFER THE ENERGY CONVERSION SYSTEM FROM HARMFUL TRANSIENTS & PROVIDE BETTER SYSTEM CONTROL

CURRENT APPLICATIONS

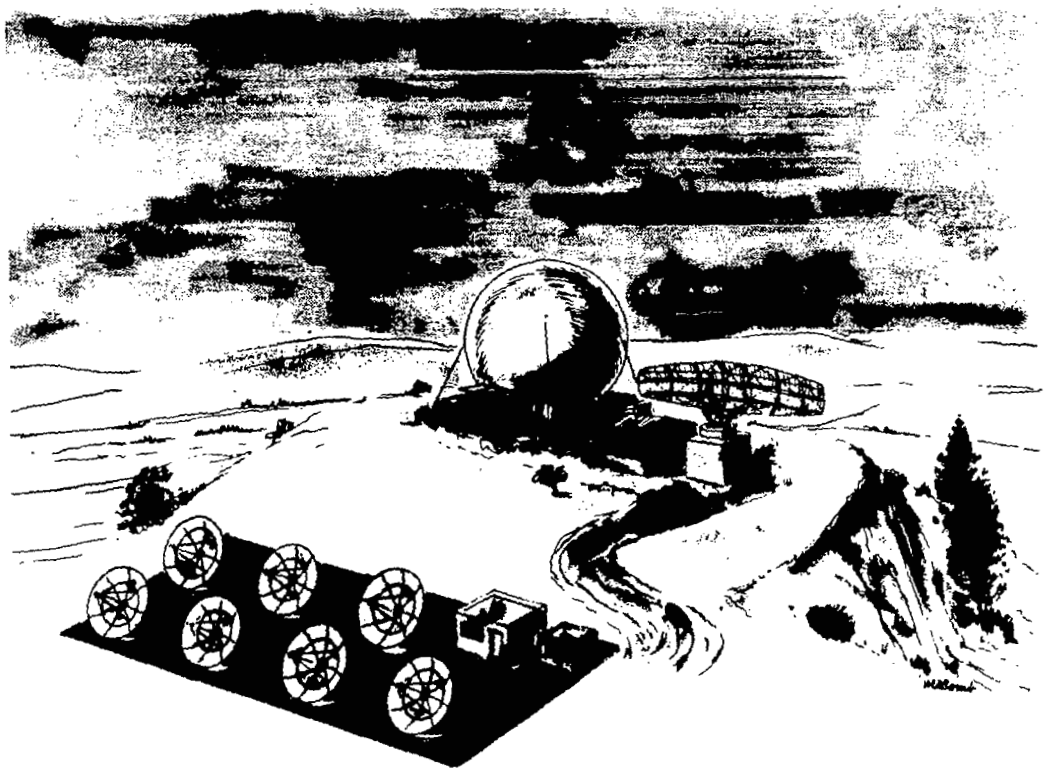
SYSTEM	ECS/SIZE	STORAGE TEMP RANGE	APPLICATION/TIME PERIOD
EE-1	RANKINE/15 KWe	800→1300^{0}F	GRID CONNECTED, SMALL COMMUNITY/1981
EE-2	BRAYTON/15 KWe	1200→1700^{0}F	ISOLATED/1981
EE-3	THERMAL LOADS	TBD	ISOLATED/1982
STIRLING	STIRLING/20 KWe	1500→1600^{0}F	ENGINEERING EXPERIMENTS 1981 SYSTEM TESTS 1984

BRIEF DESCRIPTION OF PLANT

- 1 MW PLANT USING NEAR TERM TECHNOLOGY
- APPROXIMATELY 10 ACRE SITE WITH 65 PARABOLIC CONCENTRATORS, EACH 11 METERS IN DIAMETER AND EACH HAVING ITS OWN:
  - RECEIVER
  - ENGINE
  - GENERATOR



THE ELECTRICAL OUTPUT OF THE INDIVIDUAL GENERATORS IS COMBINED AND CONNECTED TO A SMALL COMMUNITY DISTRIBUTION SYSTEM



STEAM-RANKINE SOLAR RECEIVER

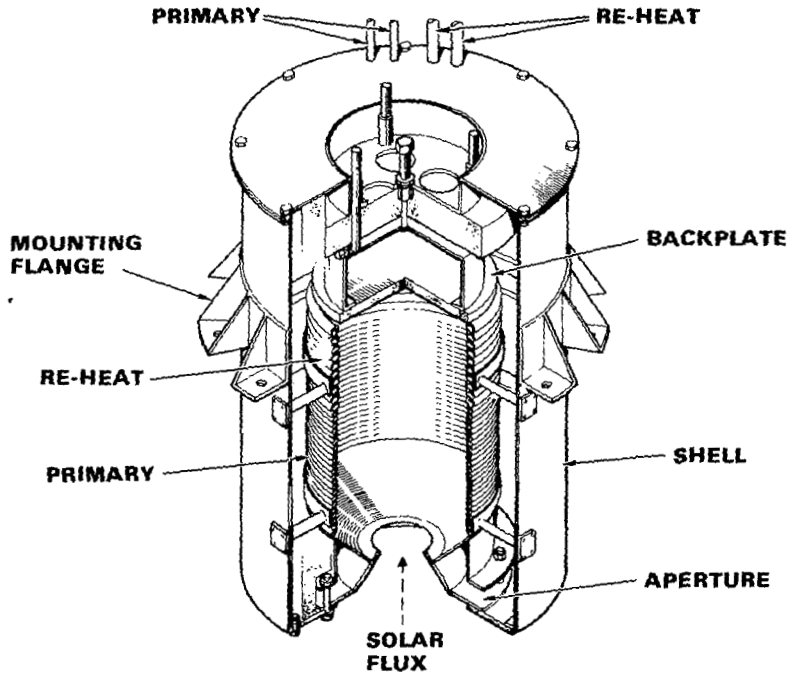
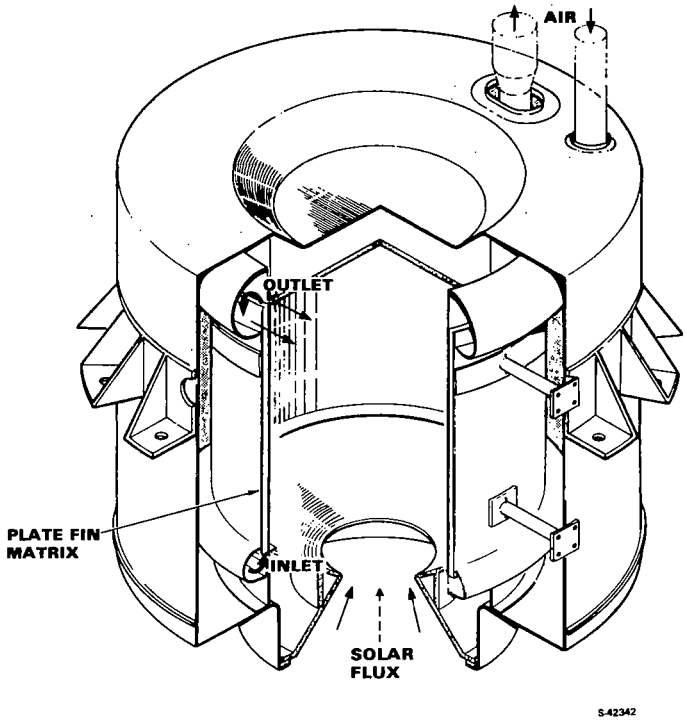
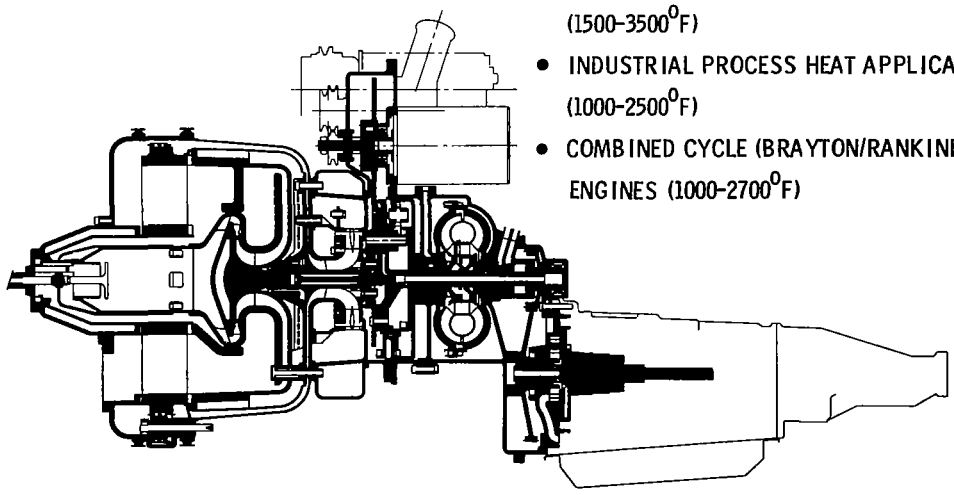


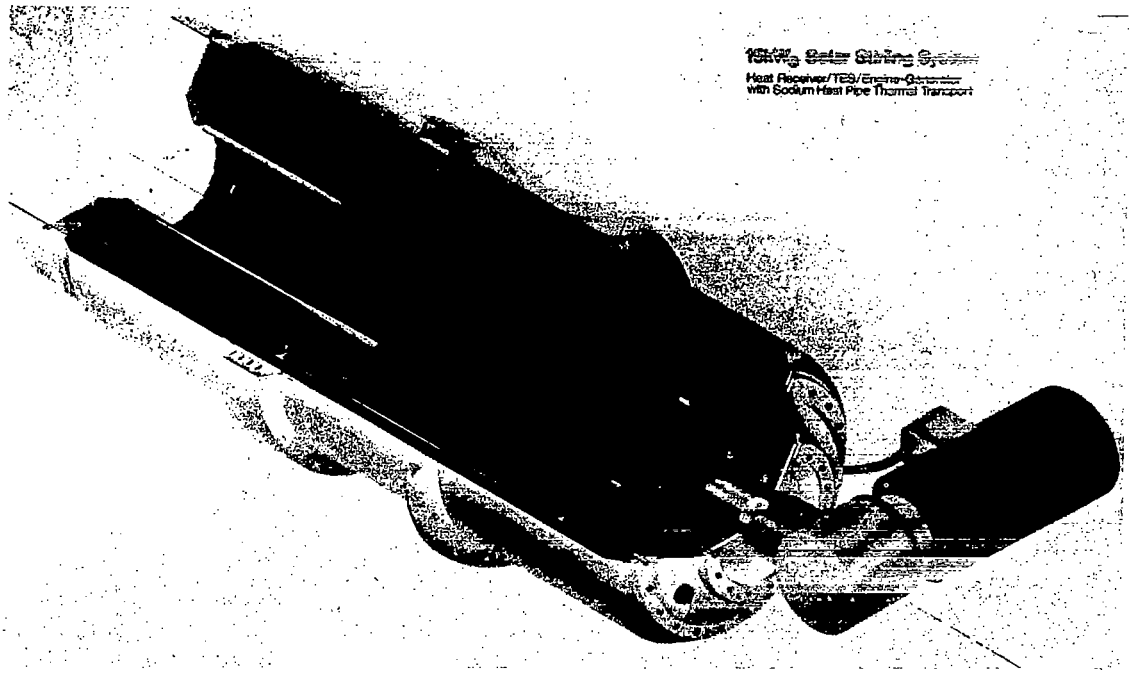
PLATE FIN BRAYTON SOLAR RECEIVER

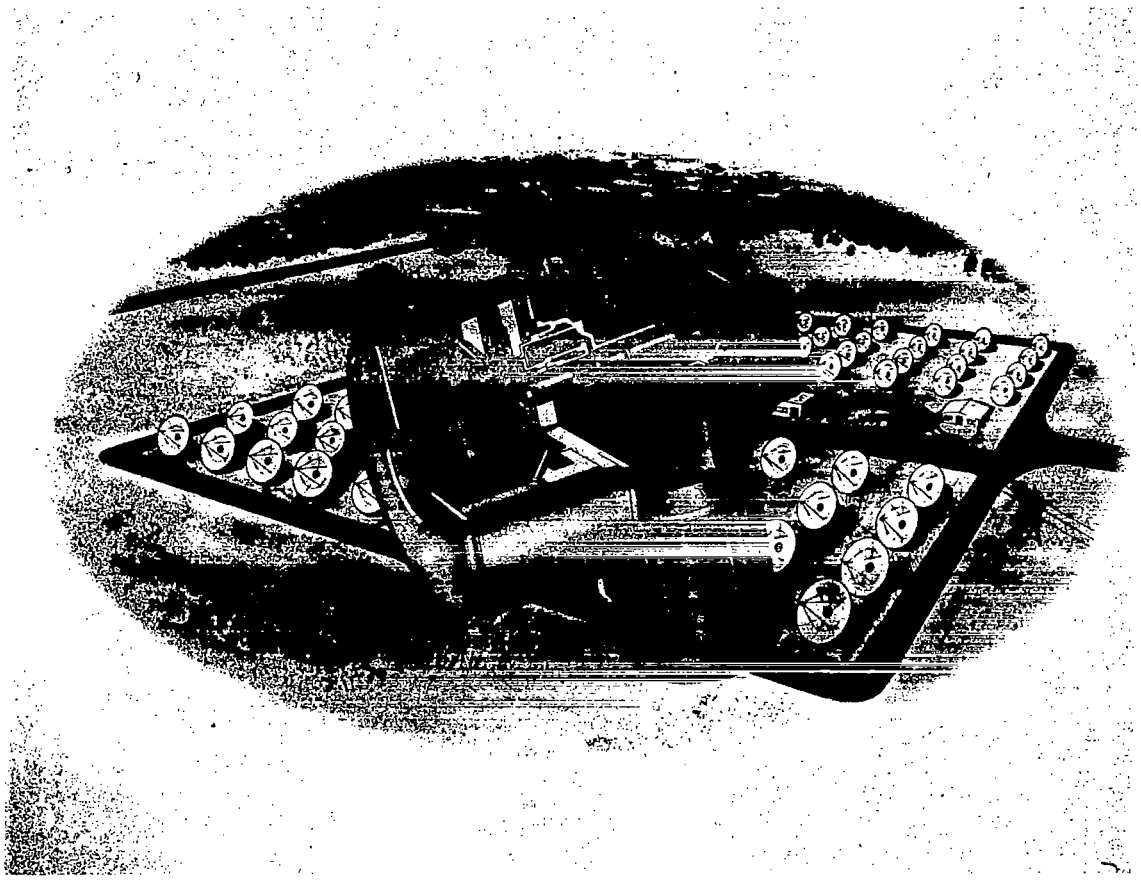


FUTURE APPLICATIONS

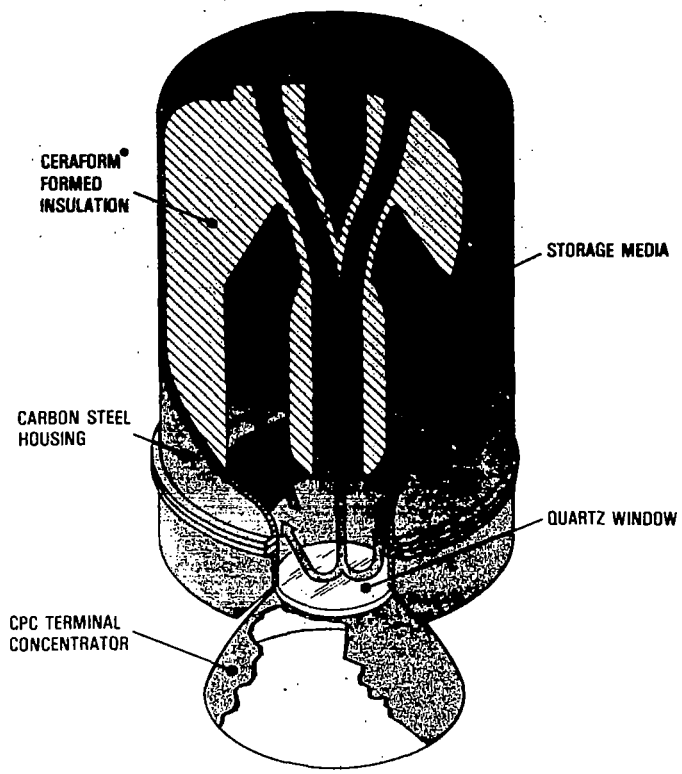
- ADVANCED BRAYTON ENGINE ($2300-2700^{0}F$)
- FUELS AND CHEMICAL APPLICATIONS ($1500-3500^{0}F$)
- INDUSTRIAL PROCESS HEAT APPLICATIONS ($1000-2500^{0}F$)
- COMBINED CYCLE (BRAYTON/RANKINE) ENGINES ($1000-2700^{0}F$)



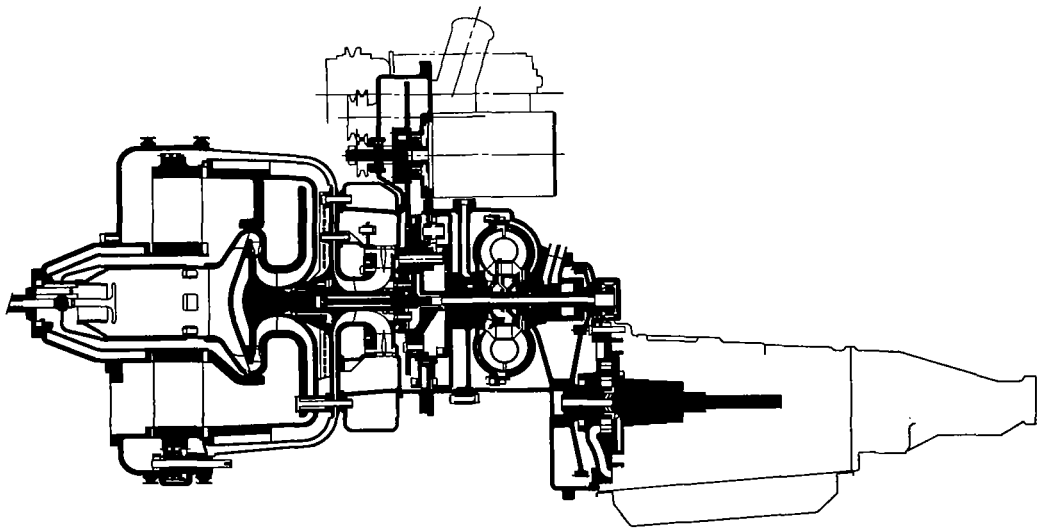

Heat Receiver/TES/Engine-Generator
with Sodium Heat Pipe Thermal Transport



PRESSURIZED MATRIX HIGH TEMPERATURE SOLAR THERMAL RECEIVER



ADVANCED GAS TURBINE POWERTRAIN



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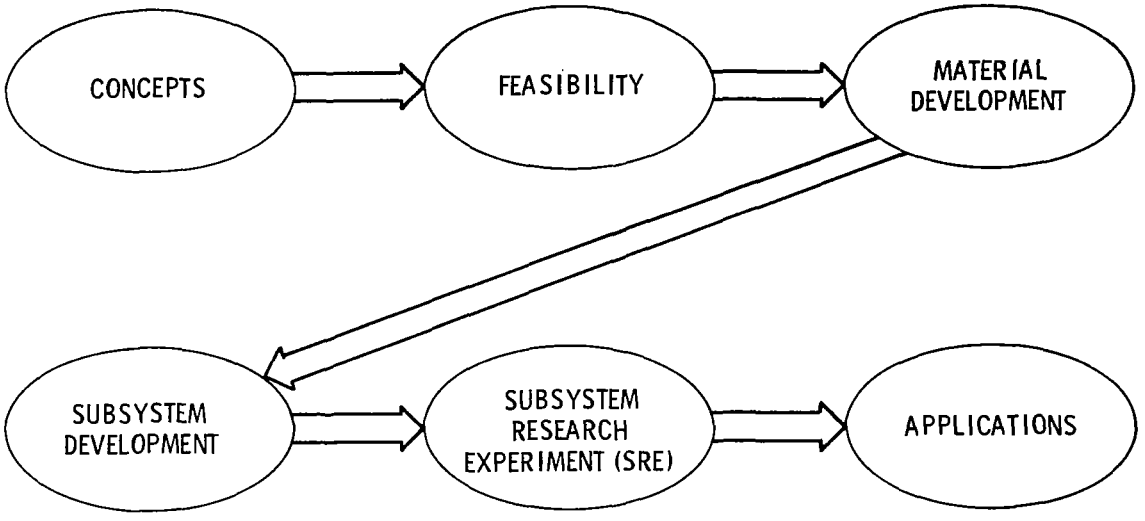
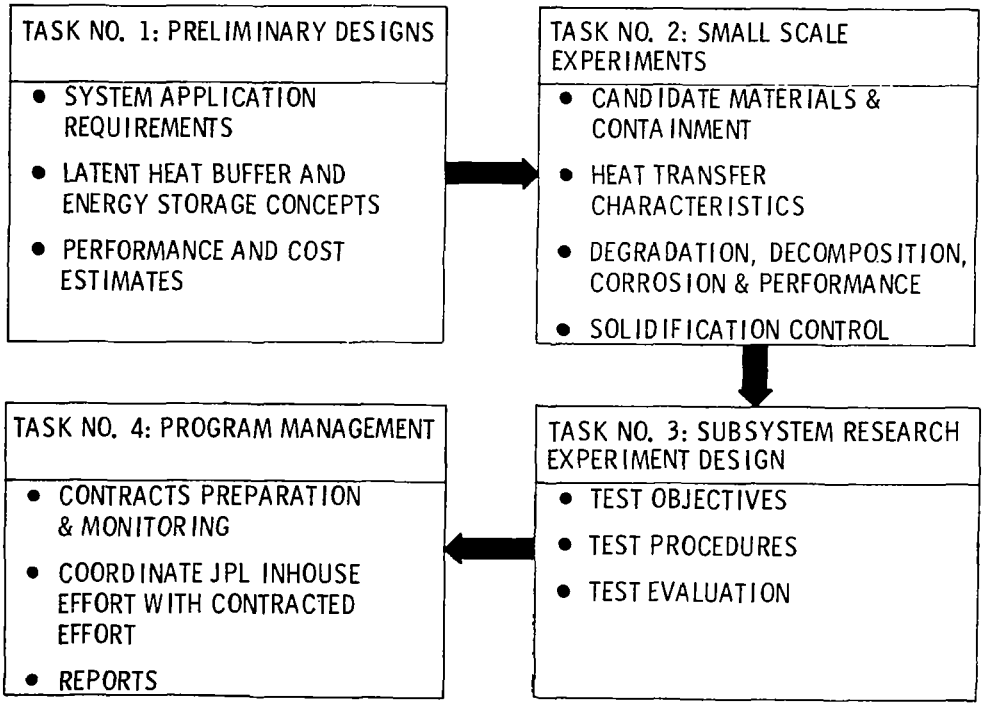
METHODOLOGY FOR THE JPL EFFORT



TASKS FOR JPL SUPPORT TO SLL



JPL IN-HOUSE EFFORT

PURPOSE: TO DEVELOP THE NECESSARY BACKGROUND, DATA BASE, AND CAPABILITY TO WRITE AND MANAGE INDUSTRIAL CONTRACTS FOR THE DEVELOPMENT OF THERMAL ENERGY STORAGE FOR DISH-APPLICATIONS.

PLANNED EFFORT IN:

- APPLICATION REQUIREMENTS
- CONCEPTS SELECTION OF ~50 KWHT TES USING PCM FOR 800-2400^{0}F TEMPERATURE RANGE
- NOVEL IDEAS OF HEAT TRANSFER AT HIGH TEMPERATURES
- STORAGE MEDIA SCREENING & SELECTION
- CONTAINMENT MATERIALS, CORROSION, AND STABILITY OF PCM
- DEVELOPMENT OF COMPUTER CODES FOR THE TRANSIENT ANALYSES OF LATENT HEAT STORAGE SYSTEMS
- DEFINE AND PLAN SUBSYSTEM RESEARCH EXPERIMENTS

A LIST OF PRELIMINARY THERMAL ENERGY STORAGE COMPONENTS

1. PHASE CHANGE MATERIALS
   - NaF (~1810^{0}F)
   - NaF + MgF_2 (~1526^{0}F)
   - NaF + KF + MgF_2 (~1265^{0}F)
   - K_2CO_3 + Li_2CO_3 + LiOH (~800^{0}F)
2. HEAT EXCHANGER CONCEPTS
   - FLEXING SURFACES
   - HEAT PIPES
   - FLUIDIZED BEDS
   - TUBE & SHELL WITH SCRAPING
3. CONTAINMENT
   - RECEIVER INTEGRATED
   - ENGINE INTEGRATED
   - SEPARATE TANK

PLANNED PROCUREMENTS

1. DEFINITION OF REQUIREMENTS FOR DISH MOUNTED LATENT HEAT BUFFER ENERGY STORAGE FOR THE FOLLOWING ENERGY CONVERSION SYSTEMS:
   - RANKINE
   - BRAYTON
   - STIRLING
2. NOVEL CONCEPTS OF LATENT HEAT STORAGE OF SMALL SIZES
3. MEASUREMENT OF THERMAL PROPERTIES OF SELECTED PHASE CHANGE MATERIALS
4. DEGRADATION AND DECOMPOSITION OF THE SELECTED PHASE CHANGE MATERIALS FOR CYCLIC THERMAL LOADING
5. SOLIDIFICATION CONTROL OF THE SELECTED PHASE CHANGE MATERIALS
6. CORROSION CONTROL OF THE SELECTED HIGH TEMPERATURE PHASE CHANGE MATERIALS
7. SUBSYSTEM RESEARCH EXPERIMENT DESIGNS

SCHEDULE