9-LSE-V8051-4

CYLINDRICAL TEMP OPTIMIZATION

Task 8

FINAL REPORT TO

LOS ALAMOS NATIONAL LABORATORY
REACTOR DESIGN AND ANALYSIS GROUP (N-12)

12 JULY 1988

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LA-5413--98-19

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PROJECT:

LANL SUBCONTRACT NO.: 9-L5E-V8051-4, TASK 8

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PROJECT PERIOD: 4/11/88 TO 7/15/88

FUNDING LEVEL: \$16,988

PRESENTATION OUTLINE

- **INTRODUCTION**
- **MODELING METHODOLOGY**
- **SUMMARY OF RECTANGULAR TEMP RESULTS**
- **CYLINDRICAL TEMP OPTIMIZATION TASK**
- **OPTIMIZATION APPROACH**
- **OPTIMIZATION RESULTS**
- **DISCUSSION OF CYLINDRICAL OPTIMIZATION**
- **THOUGHTS ON FUTURE WORK**

OBJECTIVES/INTRODUCTION

- **FIRST-CUT MASS MINIMIZATION OF
CYLINDRICAL TEMP SUBJECT TO**
 - **SPECIFIED PRESSURE HEAD**
 - **SPECIFIED FLOW RATES**
- **COMPARISON OF CYLINDRICAL TEMP AND
REFERENCE RECTANGULAR TEMP**

MODELING METHODOLOGY

- **THE INTERDEPENDENT NATURE OF THE TEMP REQUIRES A SELF CONSISTANT THERMAL-ELECTRIC & MAGNETIC MODEL**
- **THERMAL & ELECTRIC BEHAVIORS ARE CLOSELY COUPLED AND NEED TO BE SOLVED SIMULTANEOUSLY**
- **PARAMETERS ARE RELATIVELY LINEAR AND CAN BE SOLVED IN A LUMPED ELEMENT APPROACH**
- **SOLVED BY SP-100 THERMOELECTRIC-ELECTROMAGNETIC PUMP ANALYSIS CODE (STEPAC)**
- **MAGNETIC BEHAVIOR WEAKLY COUPLED TO THERMAL/ELECTRIC**
- **BEHAVIOR IS RELATIVELY NON-LINEAR; DEPENDS ON SPATIAL DISTRIBUTIONS**
- **SOLVED BY POISSON GROUP OF MAGNETIC DESIGN CODES**

MODELING METHODOLOGY

BASIC CAPABILITIES

- FULLY CONSISTANT THERMAL & ELECTRIC SOLUTION
- 1-D WITH SEPARATE N & P DIRECTIONS
- STEADY STATE
- FULL ENERGY BALANCE
- CURRENT DEPENDENT MAGNETIC FIELD STRENGTH

ENHANCEMENTS

- TEMPERATURE DEPENDENT COOLANT PROPERTIES
- FRINGE MODEL
- LUMPED PARAMETER OR AXIAL DISCRETIZATION

Equivalent hydraulic circuit of one pump pass

Equivalent electric circuit of thermoelectric electromagnetic pump