

CONF-791123--2

RELAP4/MOD6 Assessment

MASTER

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RELAP4/MOD6

- Developed at the INEL for NRC/RES by EG&G Idaho, Inc.
- Update 4 released to public in January 1978
- First version of RELAP4 code to have capability for reflood analysis

INEL-S-21 790

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Assessment Study Objectives

- **Determine code and guideline capabilities and deficiencies in calculating behavior of loss-of-coolant experiments**
- **Implement assessment procedures and evaluate adequacy of:**
 - **Procedures**
 - **Experimental data base**

Experimental Data Base

Includes:

- **NRC-sponsored experiments**
- **Foreign sources of experimental data**
- **Both separate-effects and systems-effects experiments**

Calculation Scope

- **Base-case analyses**
 - **Code calculations compared with results of completed experiments**
 - **Test predictions made prior to obtaining experimental results**

Calculation Scope (cont'd)

- **Sensitivity studies**
 - **Performed to provide understanding of differences between calculations and measurements**
 - **Make special evaluations of influential models and guidelines**

By-Products of Assessment

- **Recommendations for code use**
- **Analysis of model applicability**
- **Samples of code applications**

Assessment Procedure

- **Code evaluated against experimental data**
- **Performance evaluators and diagnostic indicators defined for each experiment**
- **Preparation of results in a form suitable for use in statistical analyses**

The Assessment Matrix

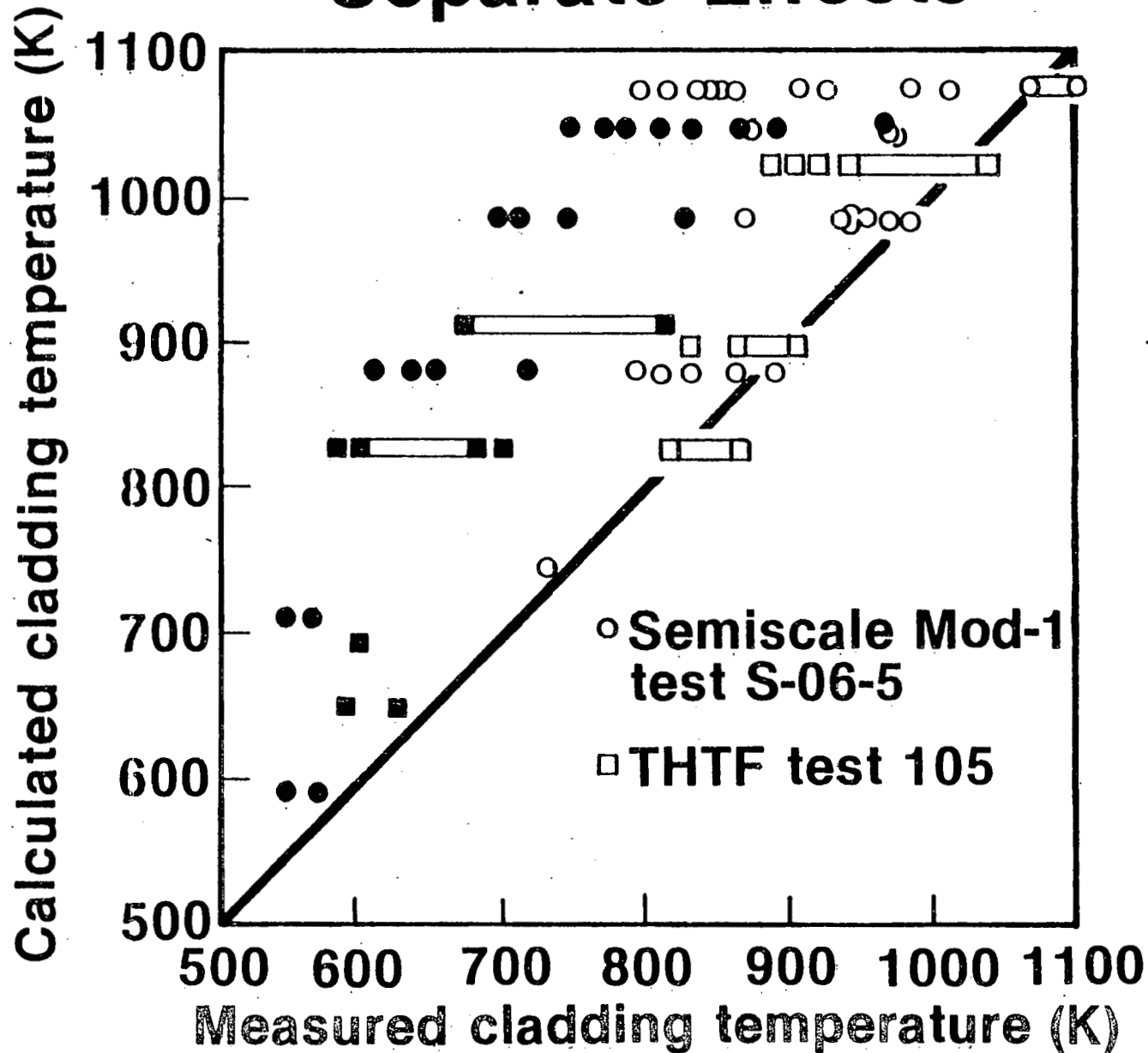
- **Included experiments from Nine Facilities**
- **Subtasks were established to provide analyses in small segments of an overall broad scope of effort**
- **The experimental source and code capability being evaluated was indicated for each subtask**
- **Eighteen subtasks were defined for which forty one base case calculations were made**

Results (cont'd)

Blowdown Systems-Effects Subtasks

Component	Performance Evaluator	Uncertainty or Error
Vessel	System pressure prior to accumulator flow	<2%
Core	Cladding temperature	
	Short core	<70 K
	Full-length core	Mean error = - 39 K Std. dev. = 34 K

Maximum Cladding Temperature for Blowdown Separate Effects

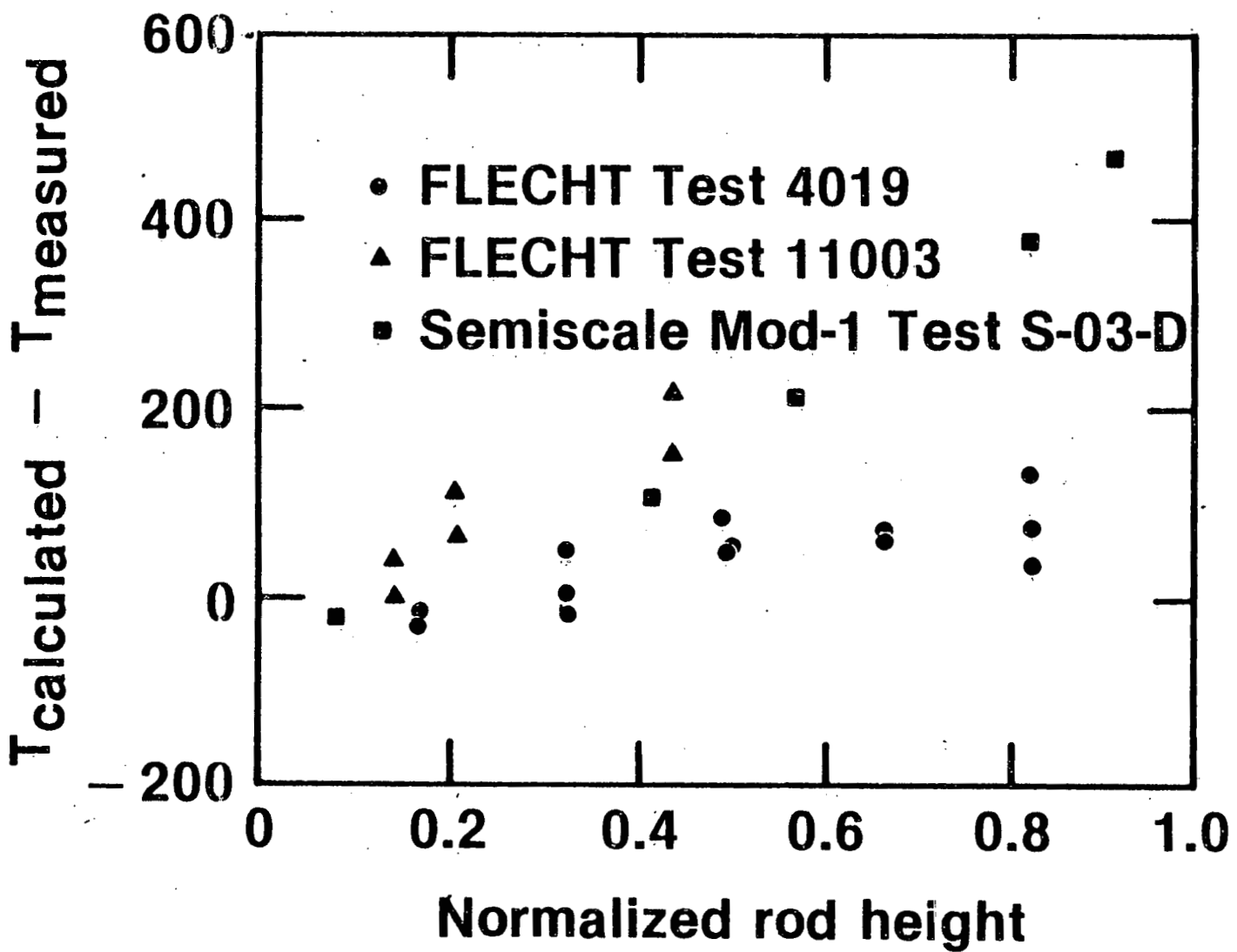


Results (cont'd)

Reflood Separate-Effects Subtask

Component	Performance Evaluator	Error
Core	Cladding temperature,	
	Lower and middle core	<100 K
	Skewed power profile	<500 K
	Quench time	< ± 100%

Error in Maximum Calculated Temperature During Reflood

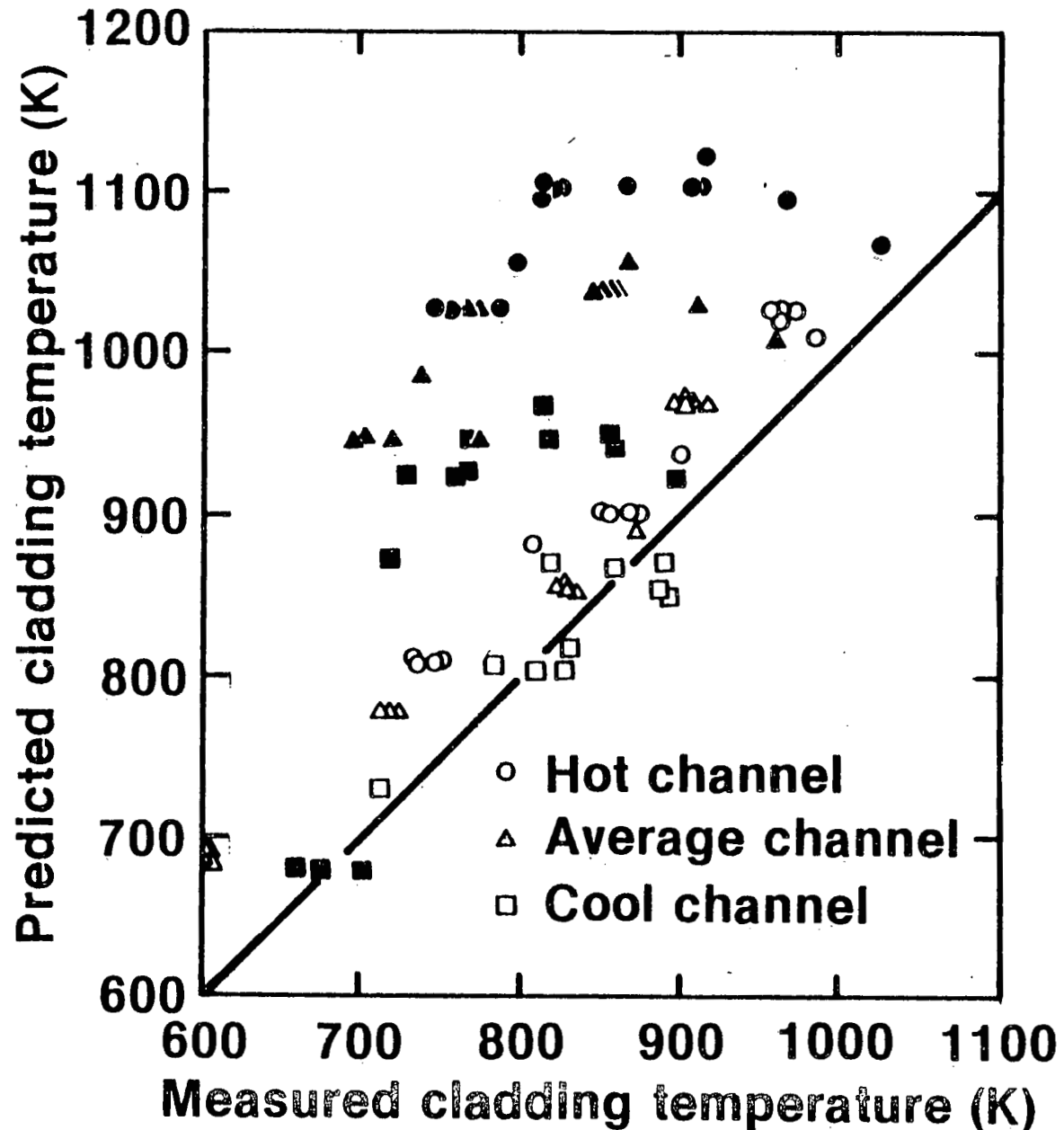


Results

Blowdown Separate-Effects Subtasks

Component	Performance Evaluator	Uncertainty or Error
Pressurizer	Pressure	<5%
	Flowrate	<23%
Core	Cladding temperature	
	Short core	Mean error = 124 K Std dev. = 103 K
	Full-length core	Mean error = 110 K Std dev. = 77 K
Critical flow	Flowrate	Mean error = 17% ± 13%

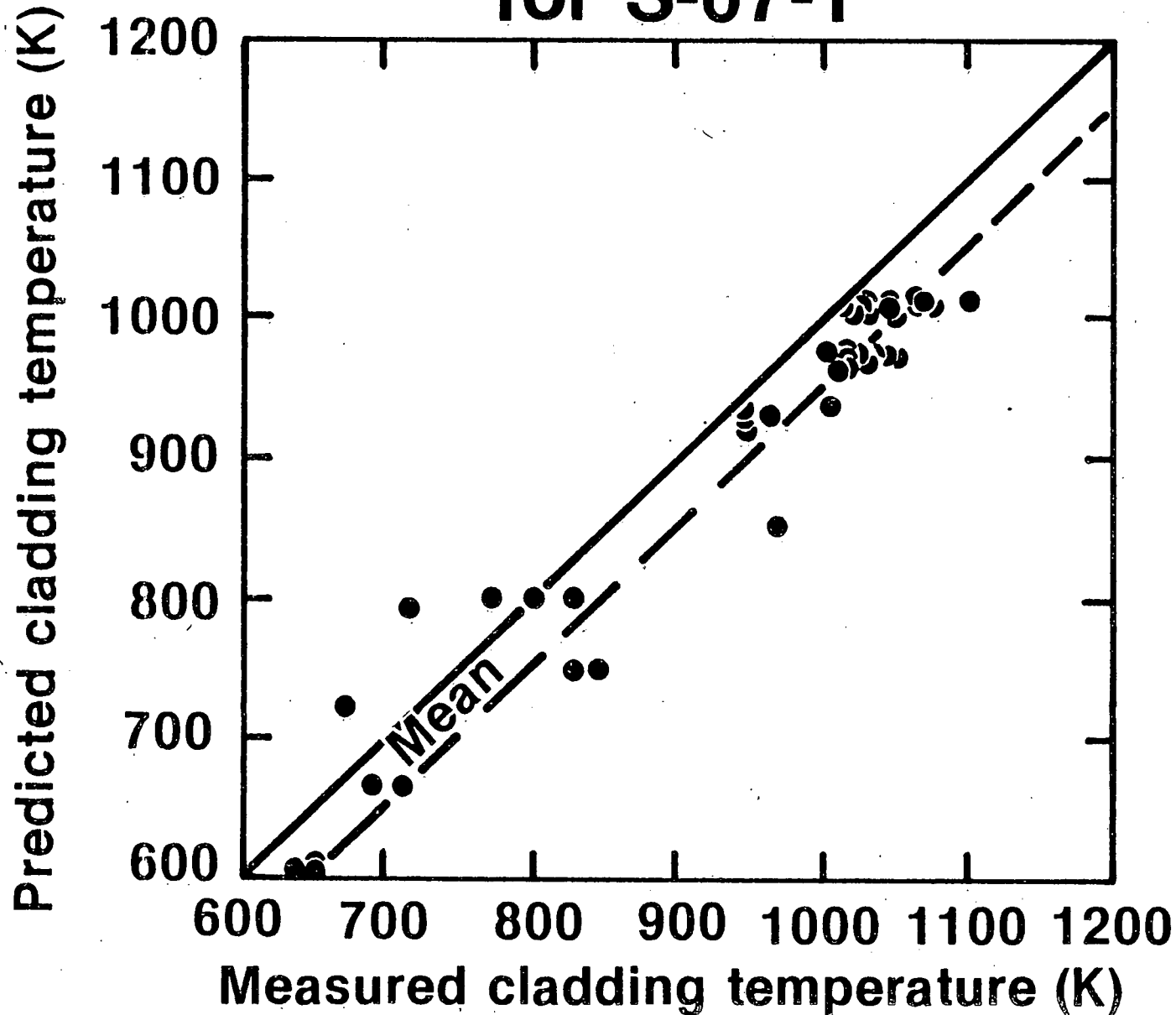
Predicted Maximum Cladding Temperature Compared to Data PKL Test K5A



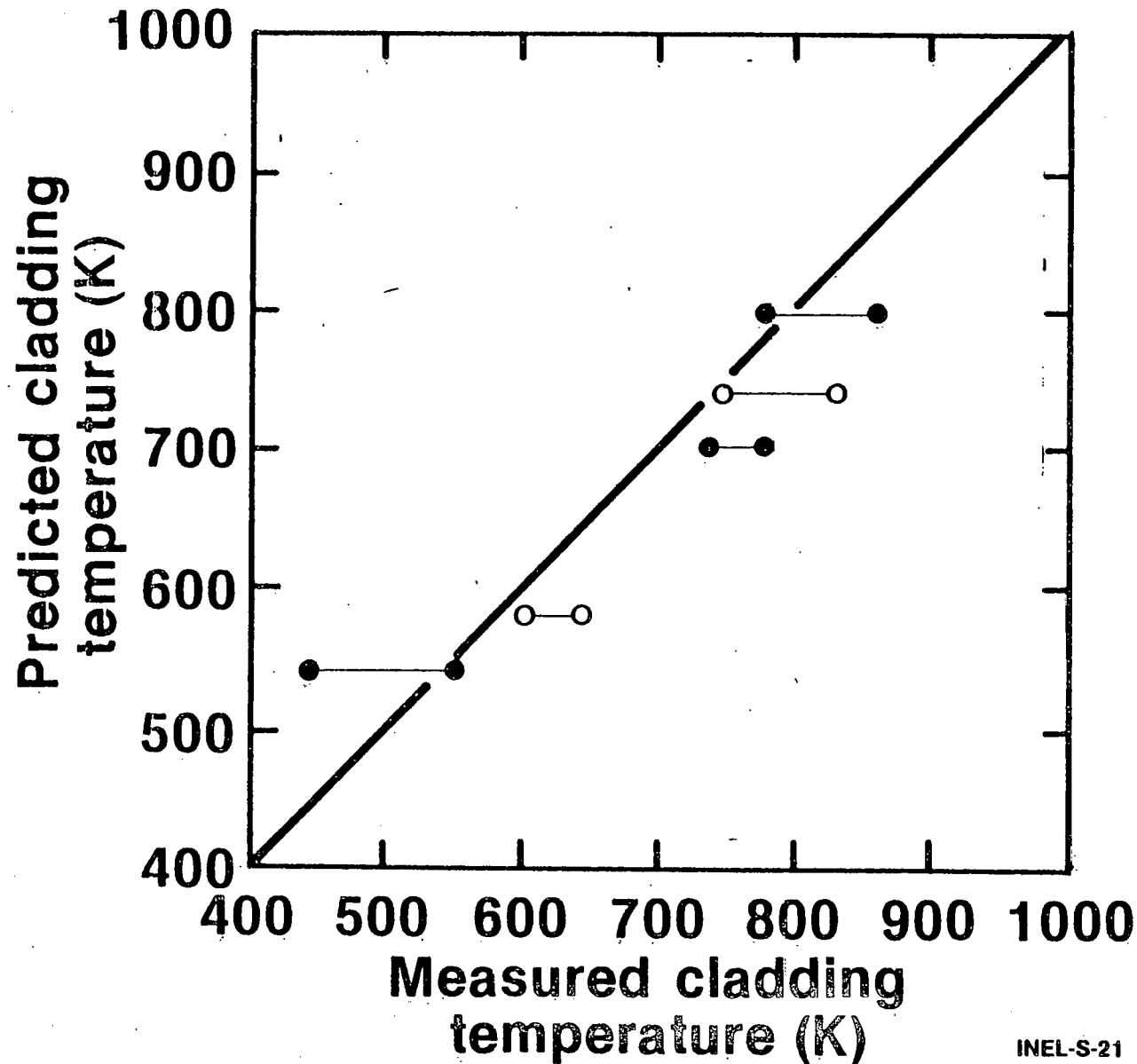
Reflood Systems Effects Subtasks

<u>Component</u>	<u>Performance Evaluator</u>	<u>Uncertainty or Error</u>
Core	Cladding temperature, upper core	<325
	Lower and middle core	<100 K

Predicted Maximum Cladding Temperature Compared to Data for S-07-1



Predicted Maximum Cladding Temperature Compared to Data for Semiscale Mod-3 Test S-07-4



Code Capabilities Demonstrated

Analytical representation of system hydraulics is adequate for blowdown and reflood

Matching of performance evaluators (maximum cladding temperatures, system pressures) for separate-effects and system-effects experiments was generally satisfactory

Code Deficiencies Demonstrated

- **Inadequacies of specific empirical models**
 - **Entrainment**
 - **Phase separation**
- **Code capability to calculate refill period limited by homogeneous, equilibrium assumption**
- **Need for improved user guidelines**
 - **Critical flow**
 - **Reflood heat-transfer/fluid phase relationship**