BEACON DEVELOPMENT AND ASSESSMENT

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C. R. Broadus
EG&G Idaho, Inc.

Idaho National Engineering Laboratory
Idaho Falls, Idaho 83401

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C. R. Broadus

EG&G Idaho, Inc.

P. O. Box 1625

Idaho Falls, Idaho 83401

The purpose of the BEACON code development program is to provide a best estimate containment analysis tool to predict the behavior under a wide range of containment-related phenomena. The BEACON code has been developed using models which represent the physics of the problem as accurately as possible within the limitations of current computer economics.

BEACON capabilities utilize the basic fluid computational method which provide a two-dimensional, two-component, two-phase, nonhomogeneous, nonequilibrium analysis. BEACON also models complex geometries with a generalized mesh coupling scheme, obstacle cells, partial flow cells, and combinations of two-dimensional and one-dimensional meshes and lumped-parameter regions. The current code version, BEACON/MOD2A, was released to the National Energy Software Center (NESC) in December 1978. This version of the code also models wall heat transfer and film condensation, accounting for the interactive effects between the wall, film, and compartment flow.

As part of the developmental assessment of BEACON, the Battelle-Frankfurt subcompartment test, Test D-15, was modeled using BEACON/MOD2A. Test D-15 consisted of six rooms connected in series with a steam break occurring in the first compartment. The rooms were modeled as two-dimensional meshes connected by one-dimensional meshes. The test was modeled for the first two and a half seconds.

The pressure transients computed by BEACON following the break agree well with the experimental results particularly in the early portion of the transient. In general, pressure differences within a compartment, both measured and computed, are negligibly small. Pressure differences in the second compartment following the break are discernable due to inertial effects.

The computed gas temperatures as compared with the measured data showed an overprediction of the temperature in the early portion of the transient and an under prediction in the later portion of the transient. The underprediction is caused by computational numerical diffusion of the steam front as the front moves away from the break location.

In addition, the computed saturation temperatures were compared to the data. These match the thermocouple data very well indicating the possibility that condensation is occurring on the thermocouples.

The overprediction of temperatures relative to the data during the early transient may be due to a slow thermocouple response time before the steam front contacted the thermocouple. To investigate this possibility further, a thermocouple was modeled in the third room as a heat sink. The calculated thermocouple temperature agreed very well with the data for that location prior to the passing of the steam front.

The geometry of Room 4 caused a jet to form across the room which results in a low pressure differential between Rooms 4 and 5. In order to model this effect with BEACON, careful nodalization was required to prevent stagnation effects.

At the end of 1979 a new code version, BEACON/MOD3, will be issued to NESC. In this version three models will be added. A best estimate correlations package will be included to govern the interphasic mass, momentum, and energy transfer. The BEACON/MOD3 package will be applicable over a wide range of conditions encountered in containment phenomena. The second model to be added is the form and friction loss model to account for wall friction and entrance and exit losses. The third model is the out-of-plane coupling model which will allow two, two-dimensional meshes to be coupled in the interior with a one-dimensional mesh providing a psuedo third dimension.

With the issuance of BEACON/MOD3 the BEACON program will enter into a period of developmental assessment. The purpose will be to define the range of containment-related problems to which BEACON is applicable. This assessment will rely heavily on large-scale containment blowdown tests such as the Battelle-Frankfurt test series. However, it will also include separate effects comparisons to assess individual modeling features of the BEACON code.

REFERENCE

1. R. A. Wells, "BEACON/MOD2A: A Computer Program for Subcompartment Analysis of Nuclear Reactor Containment - A User's Manual," CDAP-TR-051, March 1979.

2. M. S. Sahota, "BEACON/MOD3 Best Estimate Interphasic Exchange Functions," CDAP-TR-061, August 1979.

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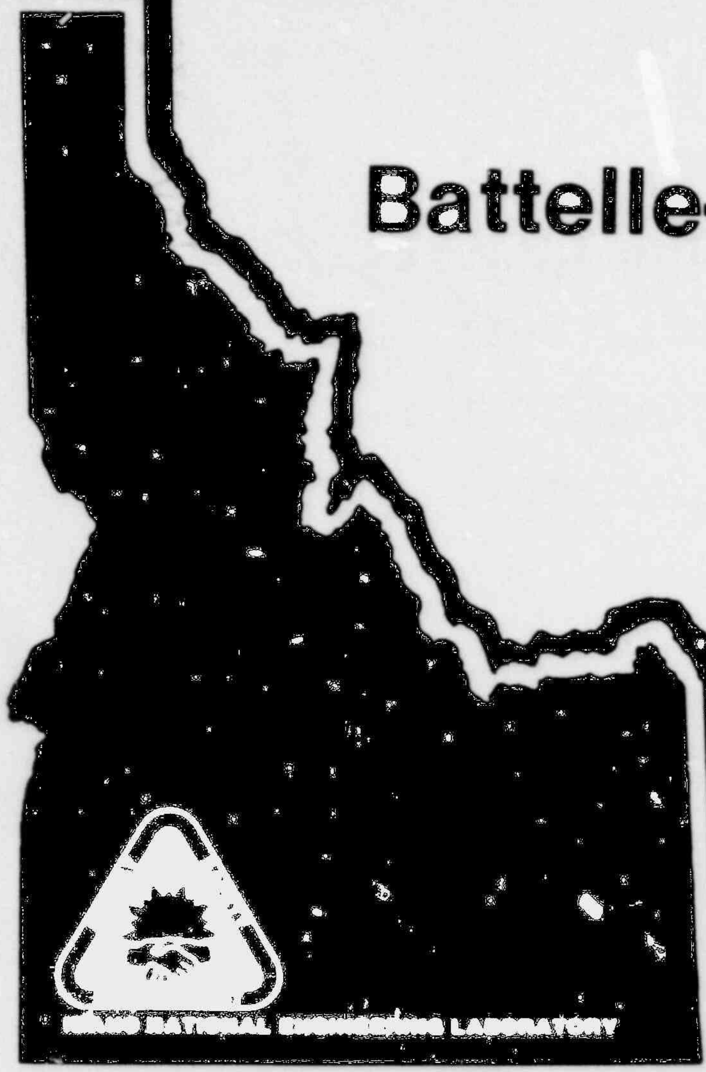
BEACON Containment Analysis Program

Battelle-Frankfurt D-15 Test Analysis



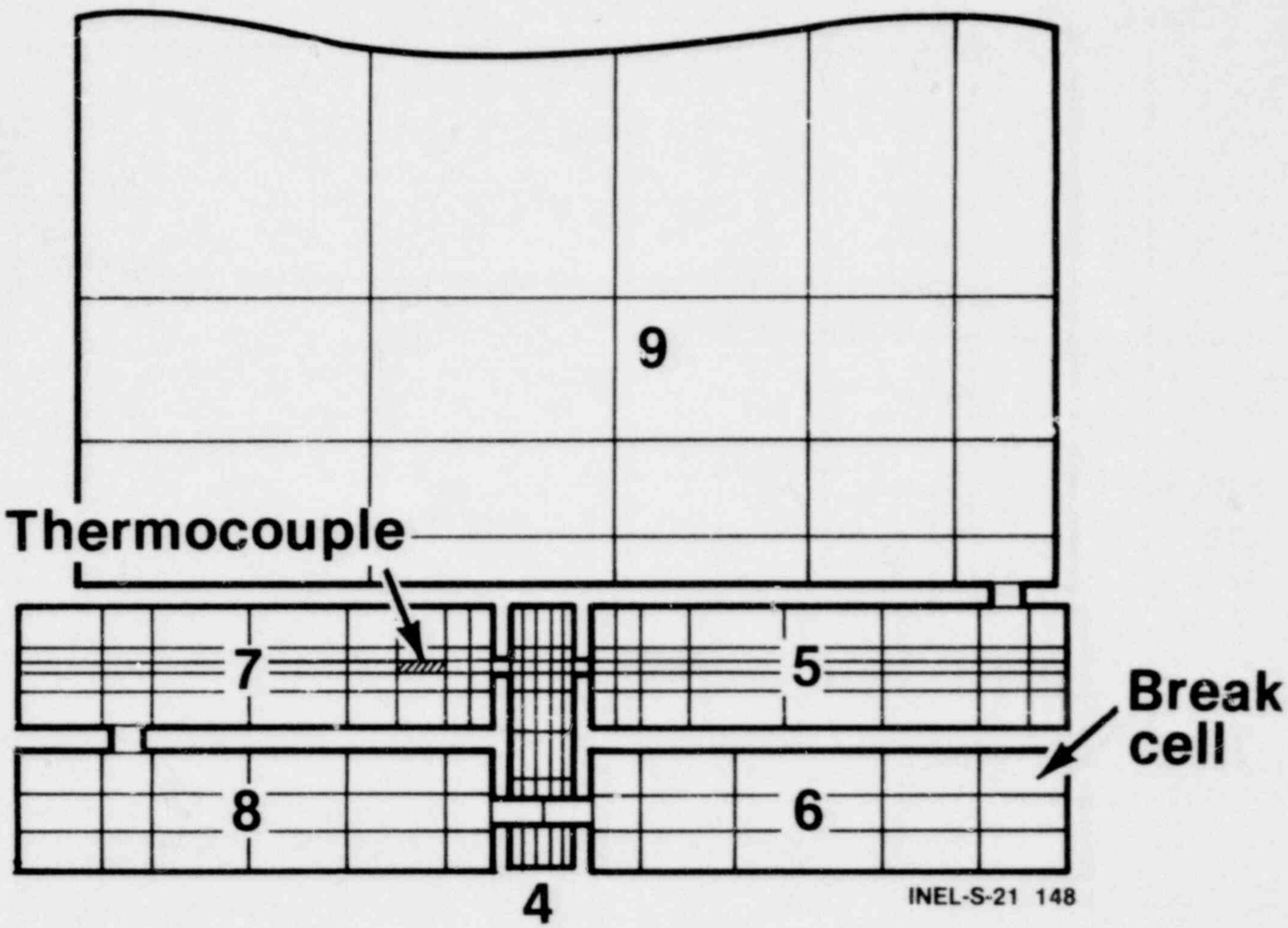
Presented by
C.R. Broadus

EG&G Idaho, Inc.

Description of BEACON

- Two-dimensional and lumped parameter
- Two-component (air and water)
- Two-phase (air/vapor and liquid)
- Nonhomogeneous and nonequilibrium
- Complex geometry modeling
- Heat transfer to structures
- Wall film modeling
- Short term to intermediate term transient

BEACON Modeling of D-15 Test Facility



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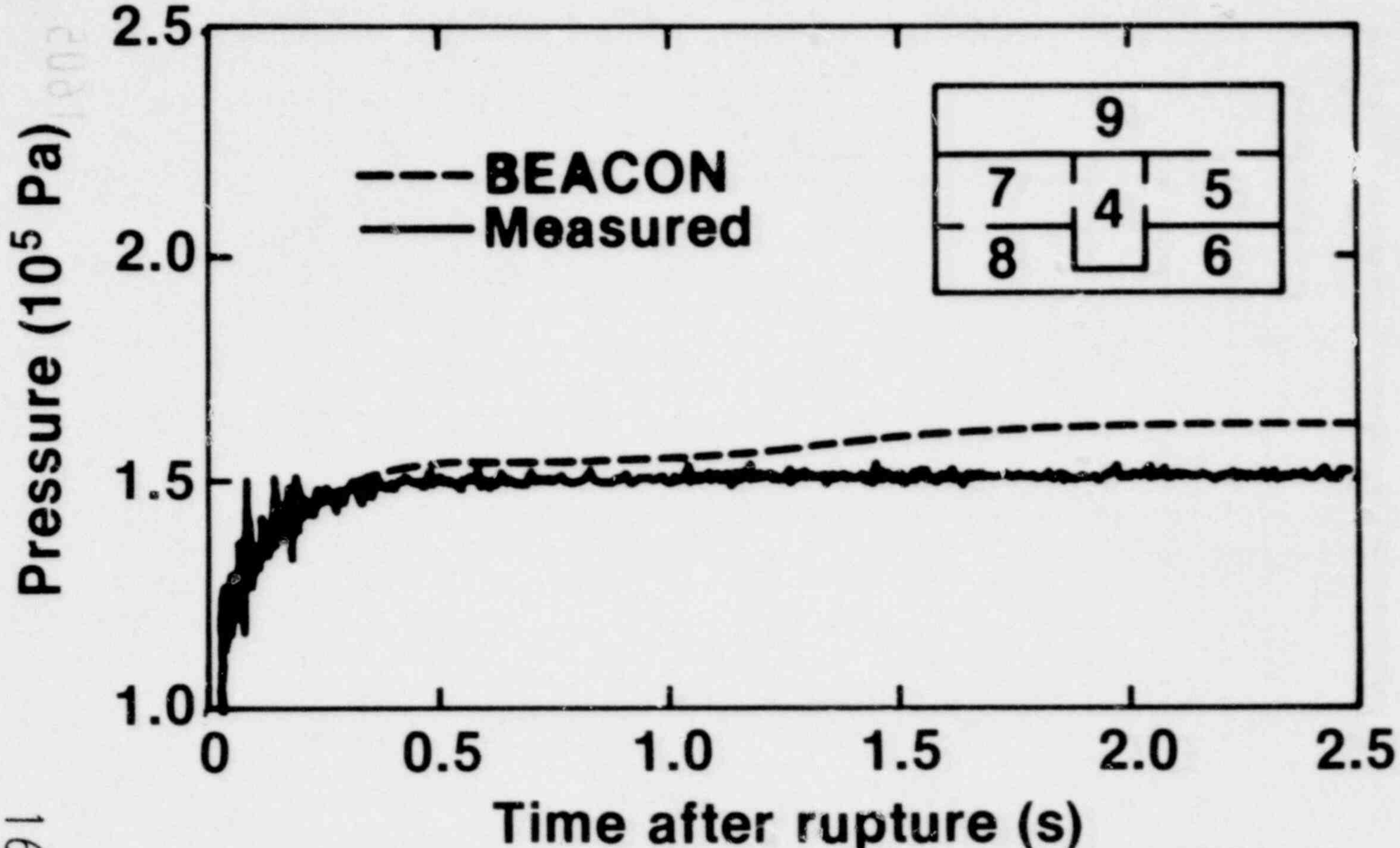
Pressure in Room 6



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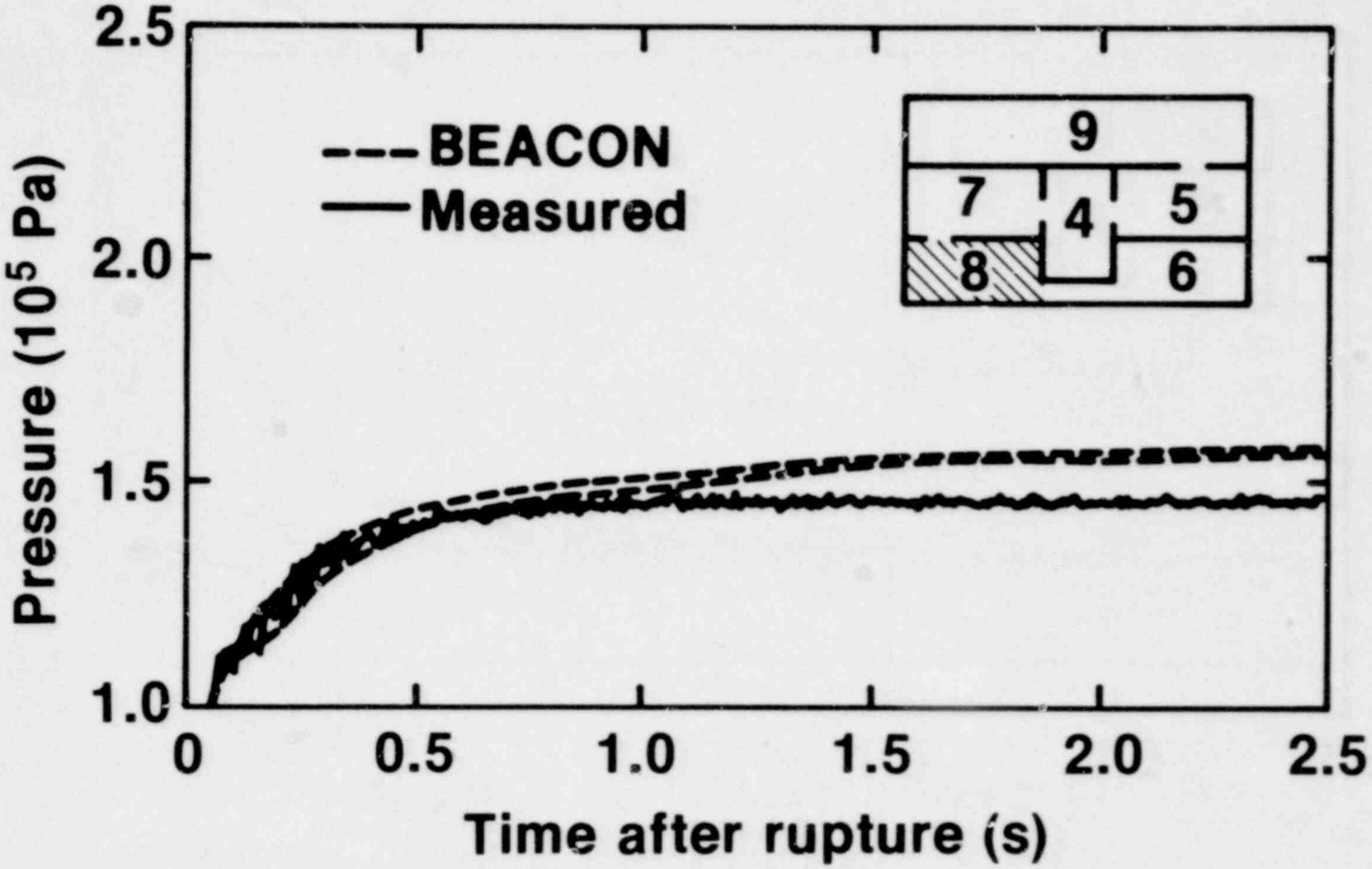
Pressure in Room 8



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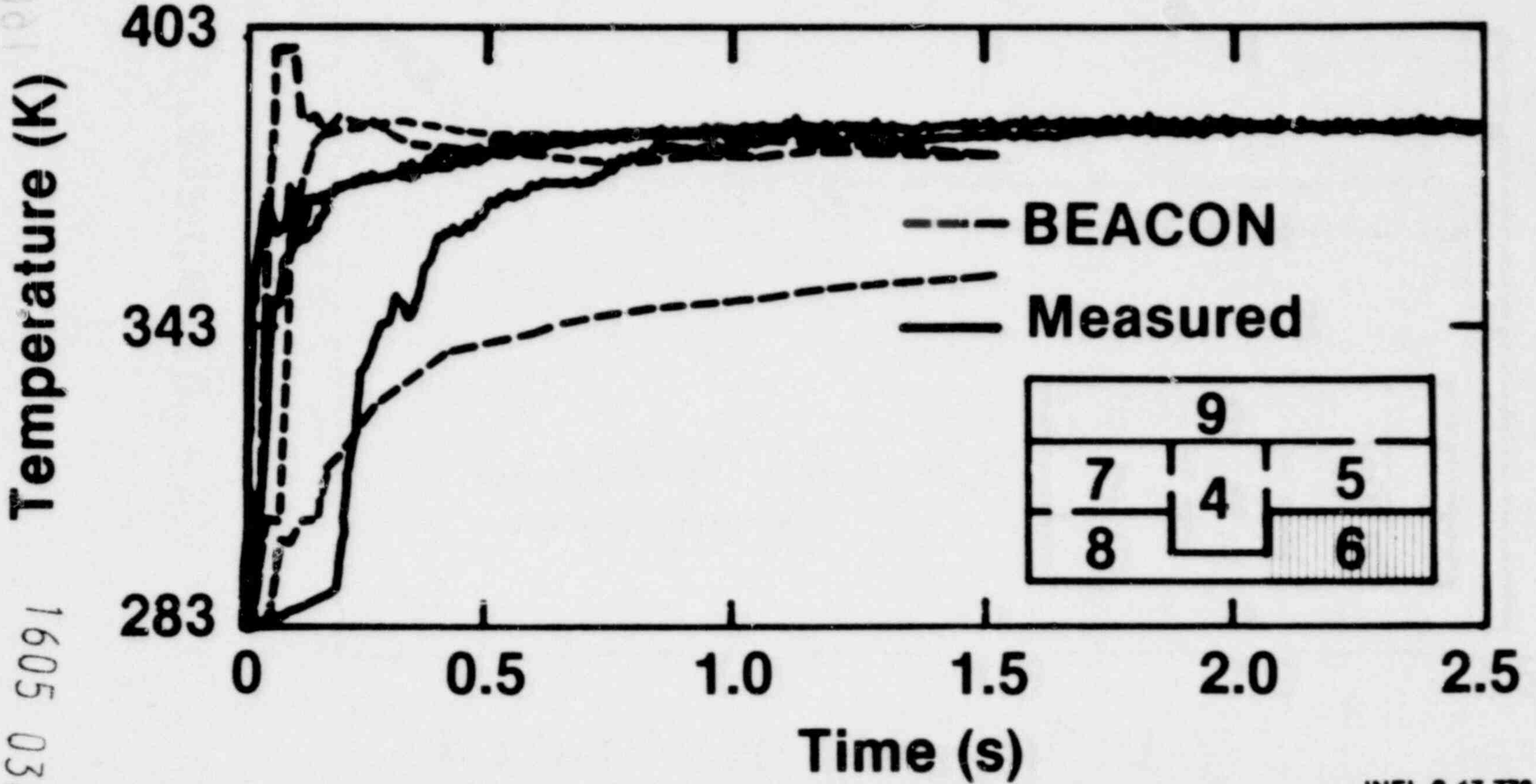
Temperature in Room 6
(Gas Temperature)



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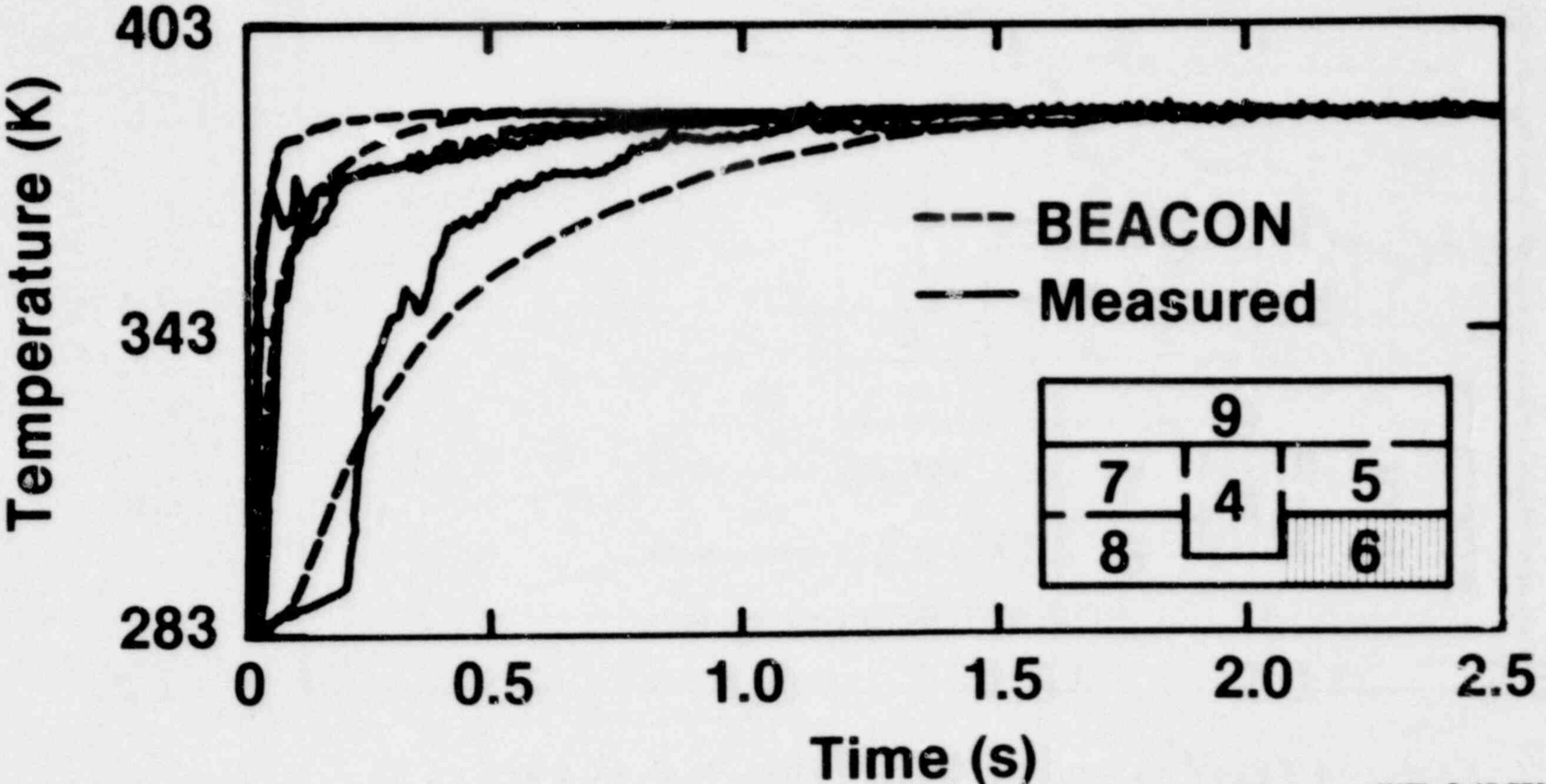
Temperature in Room 6
(Saturation Temperature)



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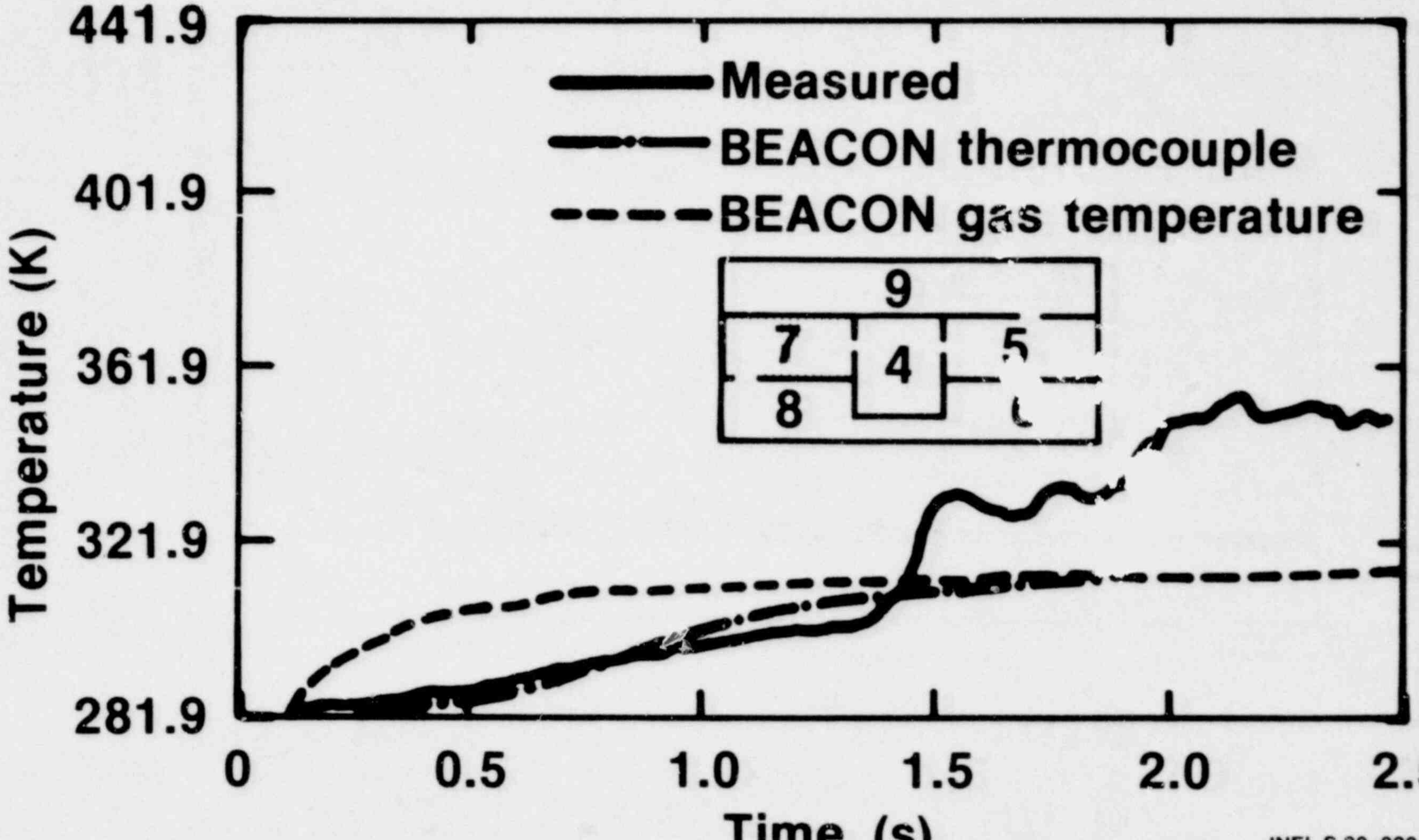
Temperature in Room 7 Thermocouple Comparison



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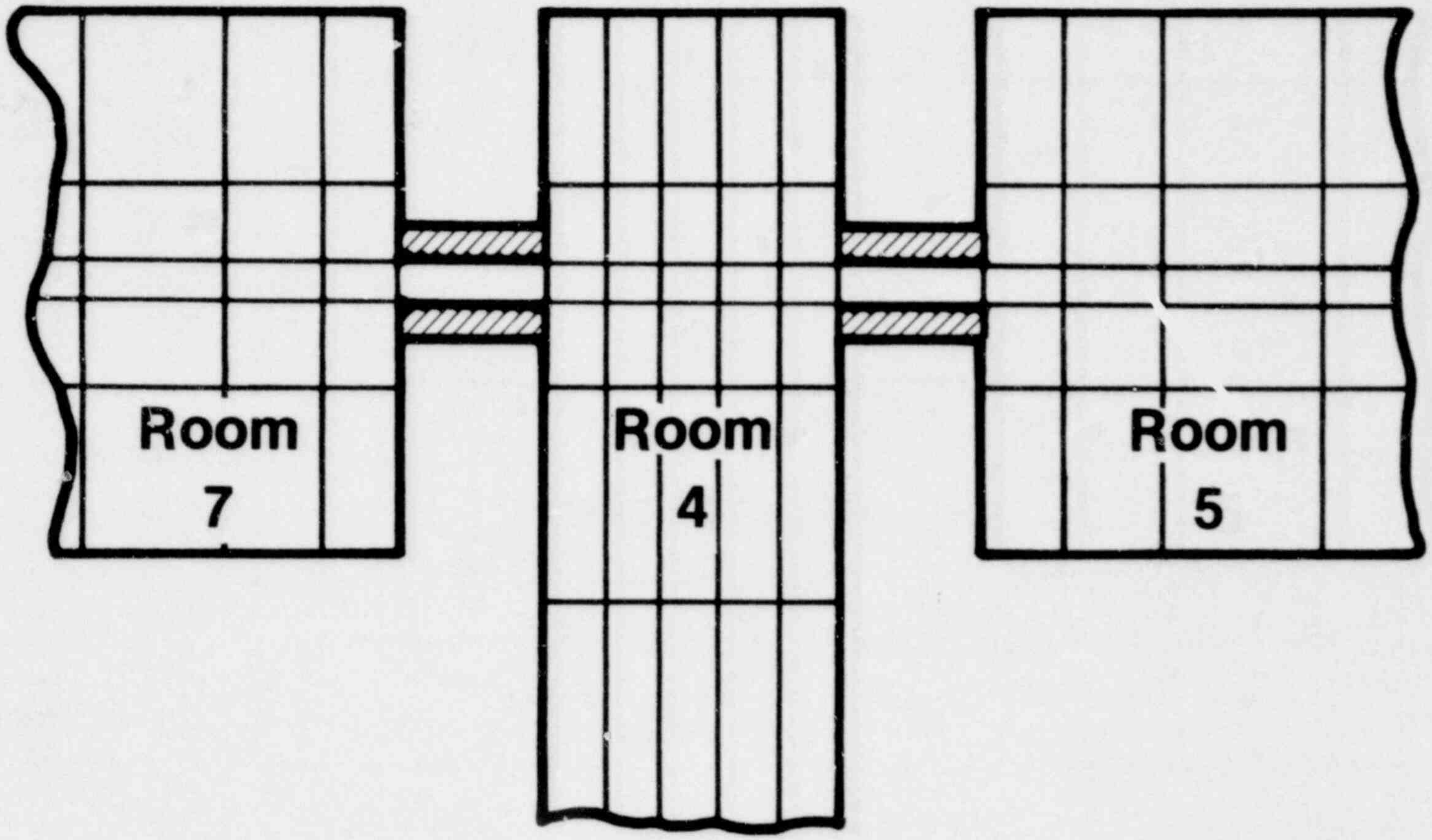
Room 4 Nodalization



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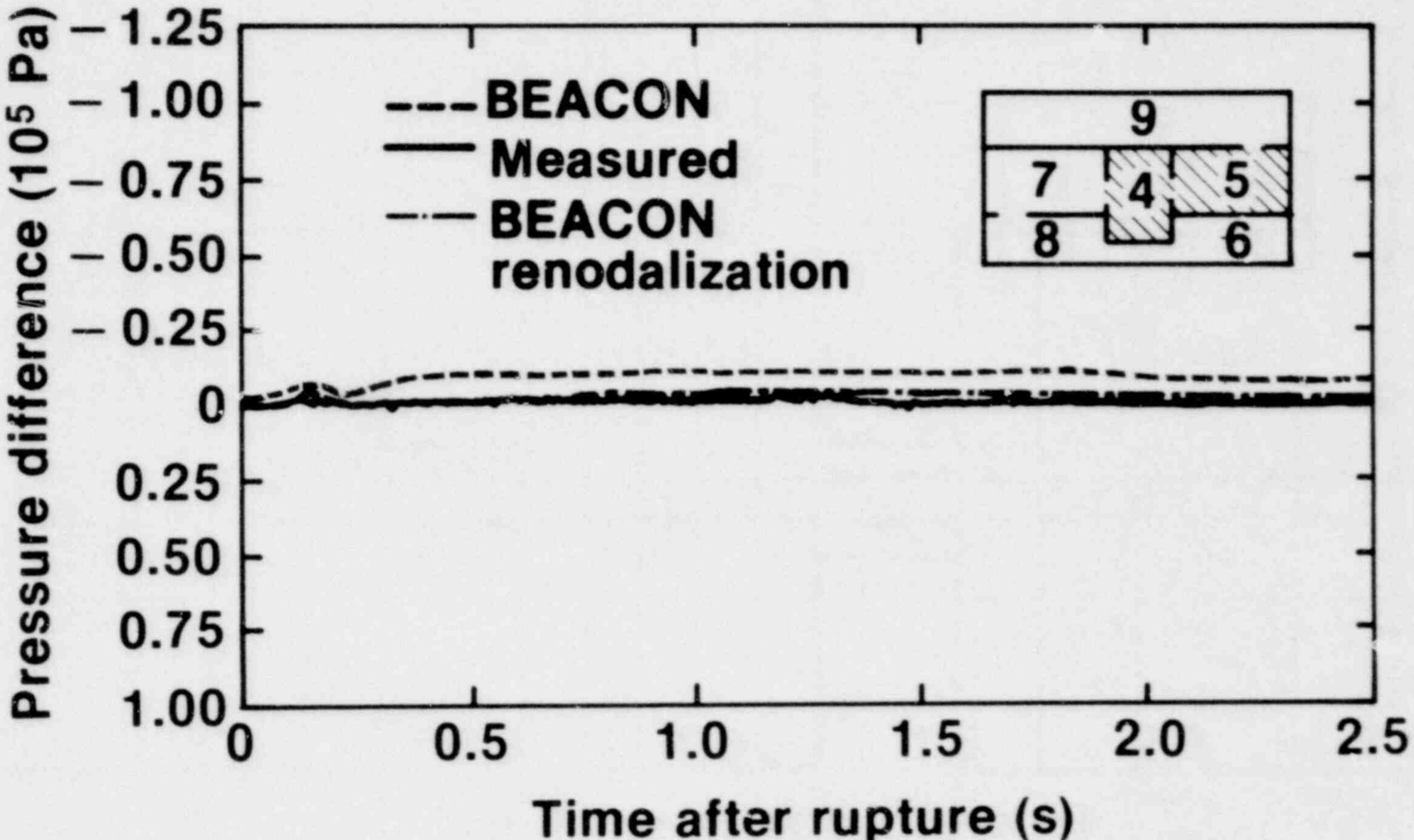
Differential Pressure
Room 4-5



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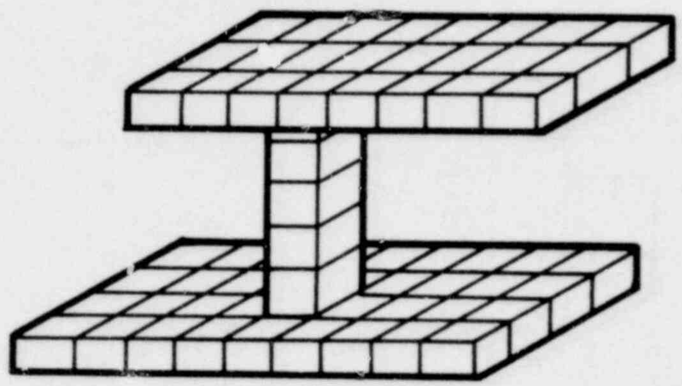
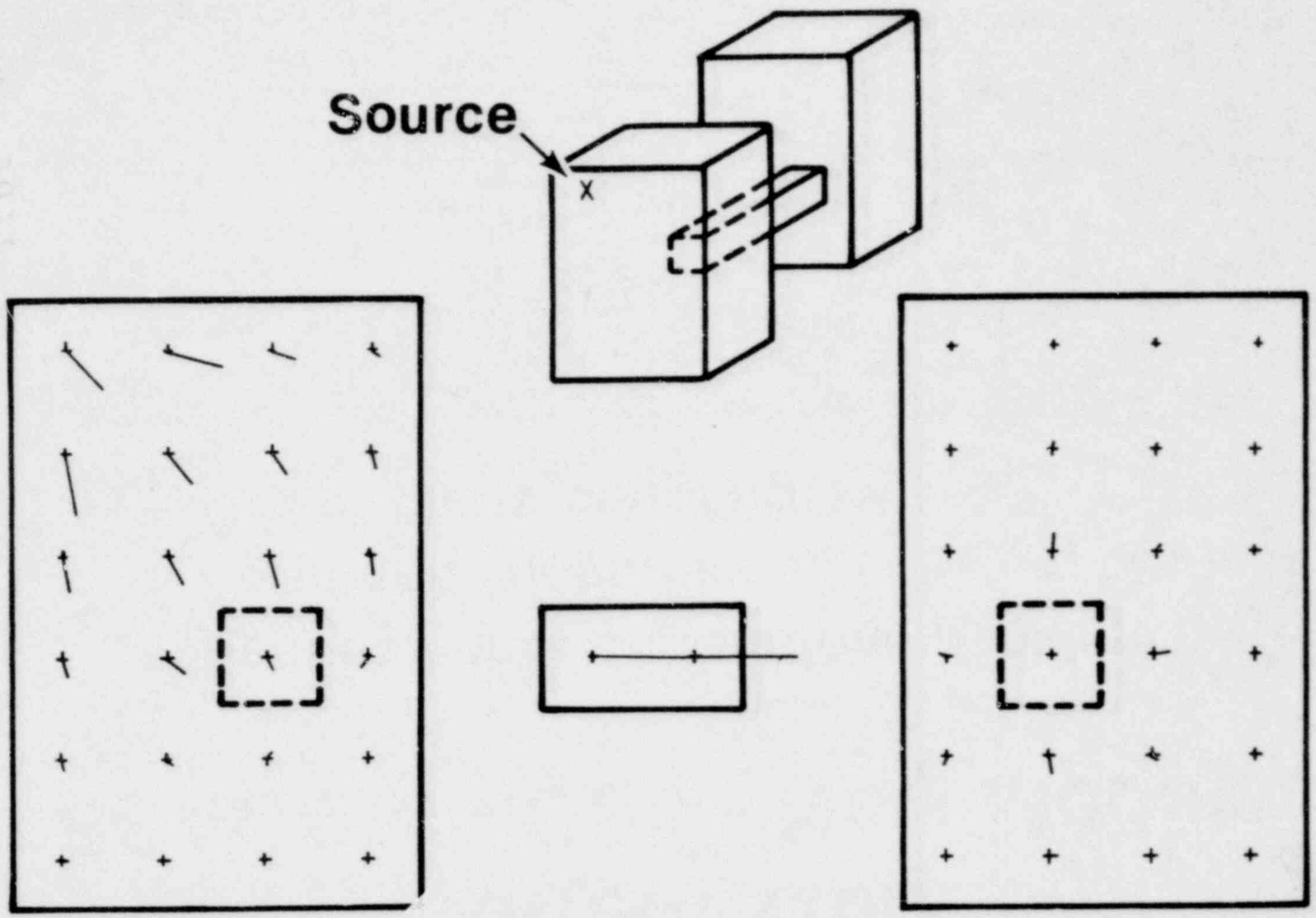
Current Work
BEACON/MOD3 - New Models

- Best-estimate correlations package
- Form and friction loss
- Out-of-plane coupling



Out of Plane Coupling Example



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BEACON
Developmental Assessment Program

Purpose: Define the range of conditions/ problems to which BEACON is applicable

Problems:

Separate Effects Problems

- Entrainment/deentrainment (DREXEL)
- 2-D separated flow (LAHEY)
- Etc.,

Containment Problems

- Battelle-Frankfurt C&D Series Tests
- CVTR Test
- Etc.,