INL/CON-07-12128
PREPRINT

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ANS 2007 Annual Meeting

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June 2007

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Battelle Energy Alliance

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INTRODUCTION

Mean velocity and turbulence data that measure turbulent flow phenomena in an approximately 1:7 scale model of a region of the lower plenum of a typical prismatic gas-cooled reactor are presented as an extension to the summary presented at the 2006 Annual Meeting [1]. The experiments were designed to develop benchmark databases to support the first Standard Problem endorsed by the Generation IV International Forum to validate the heat transfer and fluid flow software that will be used to study the behavior of the VHTR system.

EXPERIMENTAL RESULTS

Present results concentrate on the region in the lower plenum near the reflector wall that is directly opposite the outlet duct. The flow in this region of the lower plenum consists of multiple jets injecting into a confined cross flow – with obstructions. The model consists of a row of full circular posts along its centerline with half-posts on the two parallel walls to induce flow scaled to those expected from the staggered parallel rows of posts in the reactor design. Posts, side walls and end walls are fabricated from clear, fused quartz to match the refractive-index of the working fluid so that optical techniques may be employed for the measurements. The experiments were conducted in the matched Index-of-Refraction (MIR) facility at the Idaho National Laboratory (INL) using a 3-D Particle Image Velocimetry (PIV) system. Inlet jet Reynolds numbers (based on the hydraulic diameter of the jets and the average [or bulk] velocity) in the jets are approximately 4300 and 12400. The following figures are representative of the data that will be presented.

Figure 1 is a view of the time-mean velocity vector field that was obtained from the 3-D PIV system. The vector field describes the inlet jet flows in the upper right corner and the subsequent mixing of the flow as the jets turn to the left and flow toward the outlet.

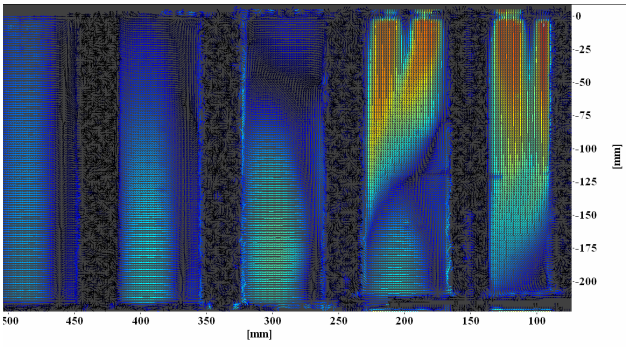

Fig. 1. Time-mean velocity vector field.

Figure 2 is a view of a horizontal slice of data describing the time-mean horizontal velocity ("Avg V_x") at about 2/3 of the depth of the plenum. The figure shows the model walls (blue), support posts (gray), the model reflector wall (yellow with black border) and the inlet jets (colored circles). The time-mean velocity field shows roughly symmetrical but complicated flow under the jets and around the support posts.

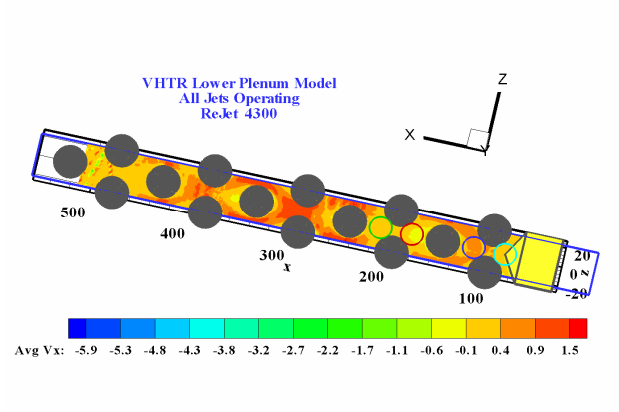

Fig. 2. Time-mean horizontal velocity at about 2/3 plenum depth.

Figure 3 presents a profile of the time-mean horizontal velocities (Avg V_x) in a vertical plane between the two support posts (intersected by the model wall) just downstream of the last inlet jet. The figure shows a generally smooth profile with reverse flow near the top of the plenum.

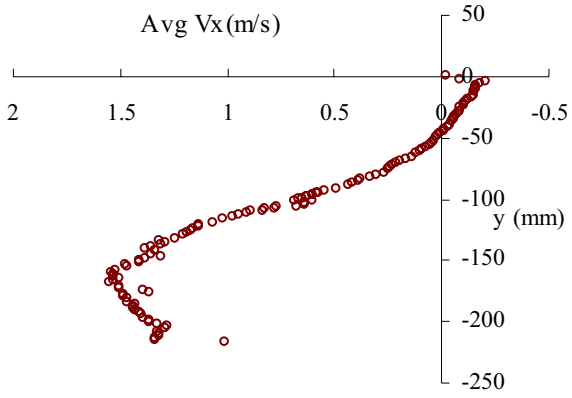

Fig. 3. Horizontal time-mean velocity along a vertical plane between support posts downstream of the last inlet jet.

CONCLUDING REMARKS

Additional experimental results of vector field and scalar field data that describe the flow phenomena in more detail and better resolution will be presented.

ENDNOTES

1. MCILROY, H. M. JR., CONDIE, K. G., MCCREERY, G. E., MCELIGOT, D. M., AND PINK, R. J., *Experimental Measurement of Flow Phenomena in a VHTR Lower Plenum Model*, Transactions of the ANS and Embedded Topical Meeting Nuclear Fuels and Structural Materials for the Next Generation Nuclear Reactors, Reno, NV, June 4-8, 2006, Vol. 94, pp. 367-368, ANS, (2006).