THREE-DIMENSIONAL MODELING OF FLOW IN WATER-PUMP INTAKES

SILVA, JOSE MATOS[1], DUARTE, ALEXANDRE CAIMOTO[2] and ECA, LUIS[3]
[1]Associate Professor, Instituto Superior Tecnico,
Av. Rovisco Pais, 1049-001 Lisbon – Portugal
(Tel: +351-21-8418148, Fax: +351-21-8497650, e-mail: jmsilva@civil.ist.utl.pt)
[2]Graduate Assistant, Instituto Superior Técnico,
Av. Rovisco Pais, 1049-001 Lisbon – Portugal
(Tel: +351-21-936737409, Fax: +351-21-7971295, e-mail: caimoto@hotmail.com)
[3]Assistant Professor, Instituto Superior Tecnico,
Av. Rovisco Pais, 1049-001 Lisbon – Portugal
(Tel: +351-21-8417992, e-mail: eca@marine.ist.utl.pt)

Abstract

Vortex formations in and around the intake pipe are common problems that lead to poor pump performance and frequent maintenance. This numerical study was performed using the code Star-CD, where the grids were generated and the calculations were run. Two turbulence models were tested: the *K-ε turbulence* model and the *two-layer turbulence model.* Particular emphasis was placed in determining the location of near-intake pipe vortices. The numerical predictions obtained in this study are in good agreement with previous experimental and numerical investigations.

Keywords: Water-pump intakes; Numerical modeling; STAR-CD; Vortices; Turbulence models

REFERENCES

Chang, E. (1977) "Review of Literature on the Formation and Modelling of Vortices in Rectangular Pump Sump", *BHRA Report No. TN 1414*, British Hydromechanic Research Association.

Chen, H.C. and Patel, V.C. (1998) "Near-Wall Turbulence Models for Complex Flows Including Separation," *AIAA Journal*, Vol.26, pp 641-648.

Constaninescu, G. and Patel, V.C. (1998) "A Numerical Model for Simulation of Pump-intake Flow and Vortices", *ASCE Journal of Hydraulic Engineering*, Vol.124(2), pp.123-134.

Li, S.H. (2001) "Three-Dimensional Modelling of Flow in Practical Water-Pump Intakes", *Ph.D. Thesis*, IST, Technical Univ. of Lisbon, Portugal.

Nakato, T., Jong, D. and Brosow, V. (1999) "Hydraulic Model Study of Red Hills Generating Facility Circulating Water Pumps", *IIHR Technical Report No. 408*, The University of Iowa, USA, September.

Rajendran, V.P. and Patel, V.C. (1998) "Characterization of Vortices in Model Pump Bay Using Particle Image Velocimetry", IIHR Report No. 396, The Univ. of Iowa, USA

Star-CD (2001) "STAR-CD Version 3.15 User Guide", *Computational Dynamics Limited.*

Tagamori, M. and Goteh, M. (1989) "Flow Patterns and Vortices in Pump Sumps", *International Symposium on Large Hydraulic Machinery*, May 28-31, Beijing.

Wilcox, D.C. (1993) "Turbulence Modelling for CFD", *La Canada-DCW Industries, Inc.*

Wilcox, D.C. (1994) "Simulation of Transition with a Two-Equation Turbulence Model", *AIAA Journal*, Vol. 32(2), pp 247-255.