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FLUID STRUCTURE INTERACTION (FSI) STUDY AT THE SMALL BORE CONNECTION (SBC) DUE TO WATER HAMMER

NUR AMALINA BINTI MUSTAFA

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ABSTRACT

Water hammer is one of the serious problem that commonly occur in the piping system. Occurrence of this problem can cause physical damage to the pipe and in worst condition, leak will happen and cause burst. The main critical area in this problem is small bore connection which can give negative impact to the structural of pipe. According to definition of water hammer, this problem normally happen due to sudden changes in fluid velocity caused by sudden closure or opening of pump and valve or electrical failure. In this study, an analysis by using ANSYS Workbench had been done at mainline pipe that have various diameter size of small bore connection. Diameter of small bore connection are varied from 1 inch (25.4 mm) to 2 inch (50.8 mm). The purpose of this study is to find maximum pressure distribution in the pipe. Result shows that highest maximum pressure distribution inside the pipe occurred when diameter of small bore connection is the smallest for both simulations using different pressure and velocities. Pressure at the point 318 mm from the inlet shows the highest pressure compared to other point. In addition, the study investigated the effect of water hammer on small bore piping by utilizing Finite Element Analysis (FEA). Through this study, the effect that occur on the structure of small bore piping can be expected on certain pressure data. From the result analysis that obtained, it found that the maximum pressure distribution occurred at inlet pressure 4826330 Pa and at inlet velocity 12 m/s at the flange termination. Maximum deformation also occurs at 1 inch small bore connection with these pressure and velocity.

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CHAPTER ONE

INTRODUCTION

1.1   Background of Studies

Water hammer is a pressure transient phenomenon which occurred due to sudden changes of velocity in the pipe (Lahane, Patil, Mahajan, & Palve, 2015). Water hammer also have varieties of name such as surge pressure and fluid hammer. Term "water hammer" also used to describe the situation that occur in a closed area which involving acceleration or retardation of the flow (KSB Know-how, Volume 1, Water Hammer, 2010). This term also described as generation, propagation and reflection of pressure waves along pipeline of pressurized liquid system that related with changes in flow condition (Bulatović & Bergant, 2014). In addition, water hammer phrases also known as pressure surge or wave that happen when fluid usually in liquid condition that flow in motion is forced to stop or change direction suddenly (Chen, Ren, Xu, & Loxton, 2015). In simple definition, water hammer is a phenomenon that happen when there are sudden changes in the flow of fluid inside pipe.

Water hammer is known as one of the major problem that industry does not take seriously. This condition can be occur in any piping system if the design does not be considered properly and follow the standard and regulation. Besides that, water hammer can also happen in many condition such as sudden valve closure or opening, sudden pump closure or opening and sudden shut off in the piping system due to electrical shortage and other related problem (Mansuri, Salmasi, & Oghati, 2014). Sometimes, water hammer can also occurred due to small leakage that happened on the pipe (Ali, Mohamed, & El-darder, 2010). Uncontrolled water hammer problem can interrupt the operation on that area and water hammer can damage and destroy system component if worst case happen (Karadžić, Bulatović, & Bergant, 2014). Water hammer can also cause physical damage on the pipe, erosion and bending of the pipe. Every effect of the water hammer will be varied depends on the material of the pipe and other parameter such as velocity, type of fluid, density, pressure and viscosity of fluid. The effect can also varied depends on the presence of support underneath of the pipe. Therefore, the