CHAPTER I
INTRODUCTION

High corrosion rates have been observed in primary outlet feeder pipes in CANDU reactors due to flow-assisted corrosion. The thinning rate is especially severe in the first few meters downstream of the Grayloc fitting where the pipe is connected to the fuel channel end fitting. Scalloping, a texturing of a corroding surface that imparts the appearance of orange peel, is often detected in the area exposed to the flow assisted-corrosion. The scallop found on outlet feeder pipe is shown in figure 1.1.

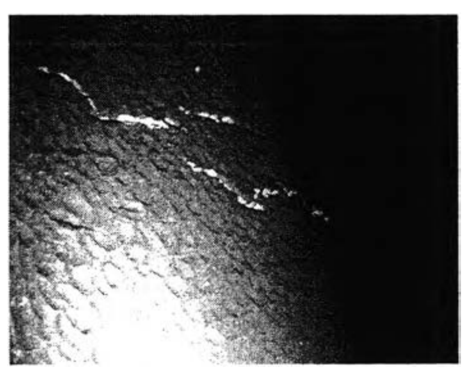

Figure 1.1 Scallop found on outlet feeder pipe k16 (Lister, 2004)

There is little understanding resulting from the research related to the scalloping phenomenon. The effects of scalloping on the system variables remain unclear. Moreover, the relation between features of the scalloped surface and other corrosion parameters is not well established.

Since scallop's surface characteristics are believed to be mainly a function of flow hydrodynamics and a weak function of surface's dissolution rate (Blumberg et al., 1974), hydrodynamics data are considered an important information in order to understand scalloping phenomena. It is beneficial to have a model that can predict the flow hydrodynamics near scalloped surface accurately.

There are a various kinds of viscous model that can be choosen to simulate the flow hydrodynamics in the CFD software such as FLUENT. Different type of viscous model can significantly change the solution. Since, there is no universal viscous model that can be applied in every kind of problem. It is important to know which model is the most appropriate to predict flow hydrodynamics near scalloped surface.

Normally, a scallop, one kind of surface roughness made by flow assisted-corrosion, has a certain value of roughness height. Even though, as indicated by the Moody chart, it should create the same pressure drop in either forward or backward flow, its special shape may lead to different pressure drops. CFD can be used to simulate the flow pattern in order to understand the hydrodynamics of scallops.

The purpose of this research is study flow hydrodynamics near scalloped surface. For the simplicity, 2 dimensional (2D) scalloped surface was used. In this thesis, FLUENT 6.3 ,Computational Fluid Dynamics (CFD) software, was choosen to be validated qualitatively and quantitatively. Flow visualization technique was applied to validate the model qualitatively. For quantitative aspect, the pressure drop measurement was performed to validate FLUENT model. The effect of a scalloped surface area and distribution on the fluid flow pressure drop was investigated.

OBJECTIVES

The objectives of this research are;

1. To study flow hydrodynamics properties near 2D scalloped surface.
2. To validate the CFD code – FLUENT 6.3 in both qualitative and quantitative approach.
3. To investigate the appropriate viscous model for predicting flow hydrodynamics near 2D scalloped surface.
4. To investigate effects of 2D scallop's surface area and distribution on pressure drop.
5. To investigate effects of flow direction on hydrodynamic properties near 2D scalloped surface.

SCOPE OF RESEARCH WORK

The scope of this research work will cover:

1. Design and set-up of the experimental equipment.
2. Study of the pressure drop effect by using acrylic transparent pipe with different machined surfaces.
3. Study of the effect of scallop's surface area on pressure drop with various Raynolds number of flow.
4. Study the effect of scallop's distribution on pressure drop with various Raynolds number of flow.
5. Study the effect of flow's direction on friction factor with various Raynolds number of flow.
6. CFD modeling of the experimental set-up and comparision with the results of the experiments.