

# A Review on the Bolted Flange Looseness Detection Method



Mohd Padzly Radzi and Mohd Hafizi Zohari

**Abstract** Early detection of bolted flange looseness in oil and gas industries is vital, as it may lead to severe problems such as leakage and explosion. The implications of this problem are not only focused on the system itself but the surrounding circumstances and coupled with the enormous economic losses associated with such failures. The use of bolts in flange structure itself can cause significant deficiencies or damage, e.g. self-looseness. In comparison to traditional methods, online monitoring has become more popular and promising in early bolt loosening detection in recent years. As one of the major flaws in bolted connection is looseness, this article aims to briefly review the bolted flange looseness detection in the oil and gas industry.

**Keywords** Fiber Bragg Grating · Structural health monitoring · Bolt looseness

## 1 Introduction

Structural Health Monitoring (SHM) has been in use for several decades to improve the safety and durability of flange connection. Furthermore, the implementation of SHM can reduce repair costs by providing early warning of possible damage to piping connections. In oil and gas industry, piping system is the dominant means of fluid transportation, hence, it is essential to reduce the maintenance costs and improve its safety. The usage of pipelines is indisputable due to the advantage of speed. The demand for pipeline expansion and maintenance is increasing from year to year as energy production increases. In the meantime, there were 1309 reported pipeline accidents as more than 143,000 km of pipelines occurred from 1970 to 2013 [1], which indicate the significant need of SHM for pipelines.

One of the common methods to connect between pipelines is by using bolted flange connections. Bolt has been used for clamping method for many years, and it is most energy-efficient and economically over long-distance [2]. Over the majority of joints, the bolt is convenient to be used and easy to disassemble [3]. Bolt specifications

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M. P. Radzi (✉) · M. H. Zohari

Advanced Structural Integrity and Vibration Research, Faculty of Mechanical and Automotive Engineering Technology, University Malaysia Pahang, Gambang, Malaysia  
e-mail: [padzly@ump.edu.my](mailto:padzly@ump.edu.my)