# OPERATION ABILITY MONITORING OF SPHERICAL TANKS BY MEANS OF ACOUSTIC EMISSION

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## Introduction

For hazardous materials stored at spherical tanks is very important to ensure operational reliability. It means that safety and risk management have always played an important role in the refining industry.
In this papar is described the use of acoustic emission as one of modern nondestructive technique. The main aim of AE application is to reduce, or minimze the potential risk of heavy accident and failure of equipment used in chemical and petrochemical industry.

Past experience shown that potential failures can occur in storage tanks, pressure vessels, pipes, reactors and other component by fracture or by cracking.
Usually there are few mechanisms which are coarsing failure individualy or in mutual combination. Some of these include fatique, thermal fatique, stress corrosion cracking, hydrogen embrittlement etc.

## 1. Thermal fatigue cracking

Due to stress caused by cyclic changes of metal temperatures in piping and vessels which occur during normal operation, catalyst regeneration or start-up and shut-down of process units.

## 2. Thermal stress cracking

Caused by high metal temperature differentials due to uneven temperature distribution in reactor catalyst beds, between hot and cold vessel components, rapid heating or cooling of piping and vessels due to process excursions and/or start-up and shut-down procedures

## 3. Hydrogen fissuring and embrittlement

Caused by teperature and/or pressure beyond material limits for hydrogen service.
This embrittlement can cause normally ductile steels to become susceptible to brittle fracture, especially during start-up and shut-down periods when metal temperatures are lower than during normal operation

## 4. Temper or creep embrittlement

Of Cr – Mo steels caused by long term exposure to temperatures in excess of 800°F (425°C).
This embrittlement can increase susceptibility to thermal-stress-induced cracking and brittle fracture, especially in the heat affected zones (HAZ) of welds.

**5. Stress corrosion cracking**

Of austentic stainless steel due to exposure to sulfur containing process streams which can form polythionic acids on exposure to miost air during unit downtimes and/or exposure to chloride containing compounds from process streams or atmospheric sources.

Any of these mechanisms can result in a significant loss of load carrying capability or structural integrity of the equipment affected. The significance of the fractures or cracks caused by these mechnisms and the extent of damage sustained to the equipment as a result of failures initiated by these cracks depends to a great extent on the type and severity of process environment, defect dimensions, location and orientation.
Experience indicates that many cracks that are initiated by the mechanisms stated above are initially slow growing and have relatively long incubation periods before hte defect reaches a critical size and rapid defect growth and structural failure occur.
Therefore, early detection and repair of defects is important in minimizing the potential for significant equipment failure and reducing the time and costs required to repair the damage equipment.

Acoustic Emission Testing (AET) is an inspection technique which is capable of detecting and locating growing defects in materials while under dynamically applied loads.
AET has several advantages over traditional inspection techniques. AET is a real time, global, non-invasive inspection technique. Essentially, 100% of the equipment being tested is monitored simultaneously during a single testing sequence. The testing is done externally so that vessel entry is not required to perform the test. Equipment can be tested while it is in service.

**Basically, AET can be applied in two modes:**

a) **Periodically** – During the planed inspection or during start-up or shut-down procedures
b) **Continuous monitoring** – During the service

**Conclusion:**

1) Acoustic Emission technique is very sensitive to discover live defects during the pressure tests
2) Location of the defects can be done on base of multichannel AE Measuring systém
3) Application of Continuous Monitoring can investigate new created defects during the service coursed by thermal gradient
4) AE in combination with the Ultrasonic Testing is improving knowledge of integrity of structure
5) Subsequently applied fracture mechanics evaluation alowes to determine safe service of inspected equipment