Best Technology Soultions **(BTS)**

Training Program

Centrifugal Compressor Performance, Operation, Maintenance & Troubleshooting.

Introduction:

Centrifugal Compressors a play a very essential role in many petrochemical and industrial plants. Centrifugal compressors in general runs at very high speeds, exposed to high temperature. The compressor operation is confined between the Surge and Stonewall limits.
The compressor performance also is affected by the variation in operating conditions. Elevated temperature and large centrifugal stresses make the gas turbine operating under very critical conditions requires very complicated monitoring and protection systems. The above very sever operating conditions enhances the machines deterioration. Accurate instrumentation, monitoring, troubleshooting and maintenance programs are essential for maintaining and increasing the available time of the machines. Understanding and learning Centrifugal compressors more deeply help smooth and free trouble operation.
During the course the design, performance, operation limits and control system are going to be addressed thoroughly. Parameters affects the above will also be discussed during the course.
Troubleshooting centrifugal compressors techniques will be covered in the course.

Who Should Attend?

Engineers and Technicians operation, mechanical, reliability electrical and instrument working on turbomachinery, turbines and compressors are the ones to attend this course.

Methodology:

This interactive Training will be highly interactive, with opportunities to advance your opinions and ideas and will include:

- Lectures
- Workshop & Work Presentation
- Case Studies and Practical Exercise
- Videos and General Discussions

Certificate:

BTS attendance certificate will be issued to all attendees completing minimum of 80% of the total course duration.

Course Objectives:

- Familiarize participant of different compressors design.
- Learn how different design parameter affects the machines performance and operation.
- Familiarize participant of the different types of gas compressors and their application
- To deepen the participants understanding of the limits of the compressor operation.
- Enable participants to read and calculate the performance curves of compressor
- To familiarize the participant with control, and protection systems of centrifugal compressor systems.
- To familiarize the participant to start and shut down the compressor in smooth and properly methods.

Course Outline:

The Following Topics will be covered in this course over five days Outlines:

Day 1

1. **Consideration in Compressors Selection**

- Discharge pressure required.
- Capacity required.
- Power supply characteristics.
- Availability and cost of cooling water.
- Space required for compressor.
- Compressor weight.
- Type and size of foundation required.
- Type of control required.
- Maintenance costs.
- Budget

2. **Positive-Displacement And Rotodynamic Compressors advantage and disadvantage**
3. **Introduction To Aerodynamics and positive displacement compressors**
    1. Definition Of Compressor
    2. Comparison between positive displacement and Rot dynamic compressors
    3. Types Of positive displacement Compressors

- Reciprocating compressor

- Labyrinth compressor
- Diaphragm compressor
- Screw compressor
- Lobe compressor
- Slide vane compressor

4. Video move for reciprocating compressor

Day 2

- **Turbo machinery compressors**

A-Types of Turbo machinery

- Axial compressors
- Centrifugal compressors

B-Centrifugal compressors types

- Horizontal split casing
- Vertical split casing

C-Centrifugal compressors components

- Casing
- Impellers
- Blades
- Rotors
- Balancing piston
- Guide vane
- Diffuse and volute

- Diaphragm
- Liquid film seal
- Carbon ring
- Labyrinth seal
- Mechanical contact seal
- Seal oil system
- Shaft bearings (radial and thrust bearings)
- Lubrication system
- Cooling system

D-The operation theory of centrifugal compressors

E-Compressor auxiliaries

- Direct drive
- Gear drive
- Couplings

F- Surge and antisurge system

- Avoiding surge
- Surge calculations
- Surge identifications

G-video move about the centrifugal compressors component

Day 3

Centrifugal Compressors operation

A- Relationship between compressor and system curves.

B- Compressor behavior in common applications.

1. Single-speed compressor drive with suction /discharge pressure control.
2. Variable-speed compressor drive with speed controller.
3. Gas molecular weight changes
4. Compressor flow increases beyond rating.

Degradation of Compressor Performance

1. A degradation that can be recovered
2. A type that cannot be recovered

Causes of Performance Variation

1. Changes in Gas Molecular Weight, MW.
2. Volume ratio effect.
3. Operating Speed
4. Changes in Inlet Conditions
5. Inlet Temperature
6. Inlet Pressure

Load Sharing

- parallel compressor configuration
- Series operation

video move for centrifugal compressor operation

Day 4

On-line performance monitoring system

Parameters Affecting the Compressor Performance

Features of Surge Control Systems:

Surge Control Operation (set Point Location)

Set Point Shift

Compressors Operation Problems

- Trouble shooting procedure
- Compressor start-up and shut down problems
- Compressor surge and wall stone
- Compressor common problems
- Problems due to off –deign operation
- Problems due to inadequate specifications
- Unique compressor problems

Compressors operation (start up and shutdown)

- The compressor permissive to start
- Typical compressor valve arrangement
- Prestart valve positions
- Purge cycle
- The anti surge control valve position
- Normal start up

- Normal shut down
- Emergency shut down

Start / stop logic tree for centrifugal compressor

Practical training on interactive compressors training program

Day 5

1-Dry seal gas

2-Troubleshooting and Maintenance

Non Destructive Inspection

Troubleshooting

- Principles of troubleshooting
- Lubrication systems
- Bearings failures
- Labyrinth failure
- Seals System
- Cleaning and Flushing
- Alignment and Balancing
- Condition monitoring systems
- Pressure and temperature measurements
- Effective Diagnoses systems
- Vibration Analysis
- Auxiliary System monitoring

3-Prédictive vs. Préventive Maintenance Techniques:

- Determination of Which Method to Use
- Machinery Reliability Audits and Reviews:
- Overview; Reliability Impact on Plants
- Examples from Recent Failure Incidents Attributed to Design Defects, Processing and Manufacturing Deficiencies, Assembly Errors, Off-Design or Unintended Service Conditions, Maintenance Deficiencies, etc.

Case Studies & Discussions, Last Day Review will be carried out.

The support tools four video movie about the principle and maintenance oF the centrifugal compressors.

Note: The Course Manual will be as WinWord documents or acrobat reader (hand made according to course outlines and the Presentation Slides which will be used during the Course it will be available for all participants on CD .