

TEST DEVICE AND METHOD FOR TESTING POWER STATION COMPONENTS

FIELD OF THE INVENTION

5 The present invention relates generally to a testing system and, more specifically, to a test device and to a method for functional testing of components used in LNG plant and power stations.

BACKGROUND OF THE INVENTION

10 Components such as Stop Ratio valves, Actuators with electrical Servo and Mechanical trip are used in LNG plants, power stations which are also used in other application as a feeder of fuel for gas turbines to provide mechanical drives. As a result of continuous harsh condition, these components are required overhauling and scheduled maintenance by highly skilled personnel. Upon completion of the overhauling of the components, a testing procedure is needed to assure that the performance of these components, for instance the Stop Ratio valves, the Control valves, the Actuators with electrical servo and Mechanical trip
15 are up to 100% performance is required, both for the safety and maximum yield.

US Patent Application No. 20120083933, entitled "Method and system to predict power plant performance", discloses a method for predicting a parameter of interest for a power plant comprising:

- 20 • receiving a power plant data set and an environmental data set as inputs to a processor, wherein the environmental data set comprises at least one of observed or expected environmental data;
- on the processor, processing the power plant data set and the environmental data set using one or more hybrid predictive models;
- 25 • generating, as an output of the processor, at least one prediction of the parameter of interest using the one or more hybrid predictive models.

US Patent No. 4512185 A, entitled "Steam Turbine Valve Test System", discloses a valve test system for closing off certain governor valves under steam flow conditions while still maintaining a substantially constant steam flow. A plurality of valve position demand signals is calculated for the respective governor valves with the signals being fully compensated
30 with respect to non-linear flow characteristics of the valve.

US Patent No. 5133189 A entitled "System And Method For Individually Testing Valves In A Steam Turbine Trip Control System", discloses a system being provided for independently testing trip valves in a multi-valve electro-hydraulic trip control system for a steam turbine. The electro-hydraulic trip control system features first and second channels arranged in series to control the pressure of a hydraulic fluid supplied to the actuator of the steam turbine throttle valve.

The aforementioned components used in LNG plant can affect the overall performance of a power plant in many unexpected ways, and therefore testing of new or modified LNG plant components before these components are put to use or in service, is very important in the operation of the power plant.

SUMMARY OF THE INVENTION

A main object of the present invention, is to provide a method for testing power station components, such that failures of overhauled Stop Ratio valves, Control valves, Ratcheting Sequencing Valves and Actuators are prevented. Before the installation of these components, enhanced protection against the occurrence of a failure must be guaranteed in order to avoid costly halts of production, and to assure safety of the operation.

It is an object of the present invention, to provide a method for testing power station components which is of higher reliability and enables more comprehensive test.

It is an object of the present invention, to provide a test device to test components used in LNG plants of a power plant comprising

- (i) a computer communicating with the components to be tested; instrumentation that will send data during the test;
- (ii) an interface for connecting the component to the test device; wherein the computer is configured for setting test working conditions; controlling actual (real time) parameters; monitoring and storing real time operation data, analyzing and processing the stored operation data and evaluating the performances when the test is finished.

Yet another object of the present invention, is to provide a test device to test components used in LNG plant of a power plant, further comprising a hydraulic scheme, an electrical scheme, and a plurality of instruments.

Still another object of the present invention, is to provide a test device to test components used in LNG plant, wherein the test device is able to simulate real valve operating condition.

Yet still a further object of the present invention, is to provide a test device for testing power station components, wherein the test device is able to perform the operation such as opening and closing of any type of hydraulic cylinder, trip valve relay, increasing or decreasing the high and low oil pressure, modifying the servo valve position, simulating a trip condition, reading internal valve pressure (SRV and GCV section), activating or deactivating solenoid; and simulating a trip condition while reading the trip closing time.

The method for testing test components used in LNG plant of a power plant according to the present invention includes a method of testing each valve after overhauling procedure to simulate a real valve operating condition.

Yet another object of the present invention, is to provide a test device for testing components used in LNG plant, wherein the device comprises a hydraulic scheme, an electrical scheme, a plurality of instruments, and computers.

Still yet another object of the present invention, is to provide a method of testing components that used in LNG plant, the method comprises the steps of:

1. connecting to be tested components to a test device, and
2. simulating actual operating condition by the computer to generate results of the test for the components.

The performing of the aforementioned method may be implemented in other gadget similar to the test device according to an embodiment of the invention. Such test device includes an interface for connecting the components to the test device incorporated a mathematical model or the like.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be explained, by way of example only, with reference to the accompanying Figures, where

Figure 1 shows a front view of a test device in accordance with the present invention.

Figure 2 is a lay out of the front panel of the device in accordance with the present invention.

Figure 3 shows a close view of the on the two pressure gauges on the test device in accordance with the present invention.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

Referring now to Figure 1, there is shown a test device (100) for testing a LNG plant components in accordance with a preferred embodiment of the present invention. The test device (100) comprises a computer (10), an exciter to ignite signals and receive feedback
 5 from positioner installed on the tested valve (12); a signal injector (11) to set and modify the valve position (through the device installed on the tested item) ; digital manometers (21, 22, 25, 26) to measure and visualize the pressure in the different sections of the tested item; digital manometers (25, 26) to measure and visualize the hydraulic pressure used to test the valve and read its feedbacks; needle valves (27, 28) and frequency regulators (29, 30) to
 10 modify the hydraulic pressure and create different test scenarios .

The test device (100) is able to trigger a component such as a valve, used in LNG plant, for instance, to function and able to read the shutdown speed of the valve required by normal operation standards. The results of the test of a component to be tested are shown on the PC and recorded.

15 In the preferred embodiment, the test device (100) has a computer (10) which is linked to the test component (100). The test device (100) incorporated with a mathematical model or the like will simulate the status of the operation data, based on a set of control parameters stored in the computer (10). Some interfaces connected to the computer (10), are connected electrically or mechanically to the devices under test. These interfaces send the data of the
 20 measured variables to the computer (10) which in real time, verify and compare them with the database on the device. These data are memorized and historicized, thus evaluating the performance of the devices under test.

In a LNG plant, stop ratio valves, control valves, actuators etc. are components used in the plant and due to continuous harsh condition , these components are required to be
 25 overhauled and maintenance by highly skilled personnel. The overhauled component needs to be tested to assure that its the performances are up to 100%, and also ensure safety to be used.

The present invention provides a method to test the performance of hydraulic actuated elements, and it has the ability to impose a predetermined stroke to the tested item (example
 30 a valve). In accordance with the present method and device, the chamber pressure of valve for leakage and pressure can be measured by using N2 or compressed air at about 29 bars. The temperature of the lube hydraulic oil can also be measured (31) by the test device (100) in accordance with the present invention.

The test device (100) is also able to measure LVDT and RVDT function and to allow calibration of the same ones to assure correct positioning of the valves. The signal provides to the computer (10) is of 0-20 mA with a scale of 0.001 movements to allow the control for servo valves, and the positioning of servo valve spool, energies and de-energies of servo valves. A data accumulation system is employed in the test device (100) together with the computer (10) and an integrated oscilloscope allowing reading of Emergency shut down speed.

The test device (100) is able to provide 7-100PSI oil pressure and 15-2200 PSI separately with a 2-way flow regulator and a stop valve positioning. All the Data and diagrams that collected from the test are recorded by the computer (10) of the test device (100) in accordance with the present invention.

The components to be tested as mentioned are components commonly used in gas turbines of LNG plant of a power plant. The computer in accordance with the present invention is a Touch Screen PC. The test device (100) is provided with a storage compartment equipped with a supply for high and low pressure lube oil. The lube oil is digitally controlled with respect to its pressure and flow direction.

A digital thermometer (31) is shown on the panel and it is used to show the oil temperature inside the oil tank. In the process of carrying out the test for the component, the oil temperature should never below +40 degree C and no more than + 60 degree C.

A servo controller (11) is provided to inject signals to the servo valve in order to adjust the position of the device under test.

The test device (100) of the present invention is able to process with an automatic sequence test.

In accordance with the present invention, an auxiliary pump is provided to the device so as to recover the oil from the tank positioned below a valve stand. A digital oscilloscope and multimeter are provided to the test device such that the reading of the oscilloscope and the multimeter can be viewed on personal computer installed on the test device.

FIG. 2 is a schematic view of the front panel of the device in accordance with the present invention.

As shown in FIG. 3, which schematically showing gauges on the panel of the test device (100) in accordance with the present invention. In another preferred embodiment, the test

device (100) is provided with two digital pressure gauges (22, 24), which show the air pressure into the stop ratio valve, and the gas control valve. There are high pressure oil and low pressure oil digital pressure gauges on the panel. Two levels are on the panel which are used to select whether to send oil to the valve or on the return line.

5 In accordance with the present invention, a method for functional testing of component used in LNG plant in a power station is disclosed, and the method comprises the steps of:

- (i) connecting a stop ratio valves to a test device , the test device comprising one or more mathematical models configured to simulate associated the component or to simulate conditions affecting the functions of the component ; and
- 10 (ii) testing the component by performing a simulation function of the component as in the field using the test device .

The method of the present invention can be used to test these components, such as stop ratio valves, control valves, actuators with electrical servo and mechanical trip. To perform the test, the components are configured to receive and transmit signals to the test device.

15 The method further comprises the step of identifying the nature of the detected control signal involved of the components. In the present method, the test device will generate an actual value to the component, simulating the control device on the plant and reading and evaluating the behavior of the component.

20 The method for functional testing of components according to the present invention is further comprising the steps of:

- (iv) obtaining data from the test device; and
- (v) comparing the data of the simulation and the one obtained directly by the tested device.

25 Although the present invention has been described in connection with the specified embodiments, it is not intended to be limited to the specific form set forth herein. Rather, the scope of the present invention is limited only by the accompanying claims.

CLAIMS:

1. A test device for testing a LNG plant component, the test device comprising:
 - (i) a computer communicating with the component to be tested;
 - (ii) a mathematical model of the LNG plant in a power plant system for simulating status and operation data according to preset control parameters being stored in the computer; and
 - (iii) an interface for connecting the component to the test device; wherein the computer is configured for setting test working conditions and the control parameters of the mathematical model and monitoring and storing real time operation data, analyzing and processing the stored operation data and performing performance evaluation when the test is finished.
2. The test device as set forth in Claim 1, wherein the component includes stop ratio valves, control valves and actuators with electrical servo and mechanical trip used in gas turbines.
3. The test device as set forth in Claim 1, wherein the computer is a Touch Screen PC.
4. The test device as set forth in Claim 1, further comprising a storage equipped to supply high and low pressure lube oil to the to be tested component to allow functional test to be carried out.
5. The test device as set forth in Claim 4, wherein the lube oil is digitally controlled with respect to its pressure and flow direction.
6. A method for functional testing of component used in LNG plant in a power station comprising the steps of:
 - (i) connecting a stop ratio valves to a test device as set forth in Claim 1, the test device comprising one or more mathematical models configured to simulate associated the component or to simulate conditions affecting the functions of the component ; and
 - (ii) testing the component by performing a simulation function of the component as in the field using the test device as set in Claim 1.

7. The method for functional testing of component as set forth in Claim 6, wherein the component comprises stop ratio valves, control valves, actuators with electrical servo and mechanical trip.
- 5 8. The method for functional testing of component as set forth in Claim 6, wherein the component is configured to receive and transmit signals to the test device.
9. The method for functional testing of component as set forth in Claim 6, further comprising the step of identifying the nature of the detected control signal involved of the component.
- 10 10. The method for functional testing of component as set forth in Claim 6, wherein the test device generates actual value to the component.
11. The method for functional testing of component as set forth in Claim 6, wherein the test device simulates the behavior of the component.
12. The method for functional testing of component as set forth in Claim 6, the method further comprising the steps of:
 - 15 (iv) obtaining data from the test device; and
 - (v) comparing signals between the data of the simulation and that obtained directly by the test device.
13. The method for functional testing of components as set forth in Claim 6, wherein Nitrogen or compressed air up to 29 Bar is employed for measuring valve leakage.