ATTACHMENT NO. 9

MWI FIELD TRIP REPORT DURING INTIAL TESTING OF PUMPING EQUIPMENT DTD 24 APRIL 2006

MWI FIELD TRIP REPORT
By
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Upon arrival at the test facility on April 18th the company was setting up for a fourth prototype test. I was briefed by Maria Garzino, a Mechanical Engineer temporarily assign to the New Orleans District. The working relationship between the contractor and Maria was strained. Maria said the contractor has been having a problem with hydraulic pump failures and she felt the contractor has been uncooperative in allowing her to do her job. Other concerns were that the test environment was unsafe and test procedures were poor. In my opinion, the test procedures and setup were poor, conditions were of questionable safety, and the contractor was reluctantly cooperative. The test tank was barely sized for the pump being tested. The manufacturer had to move the pump from one end of the tank to the center in order to get better inlet conditions for the impeller. In the center of the tank, the pump discharge was too close to the wall and water would splash from the tank. The plywood can be seen in Figures 1 and 2. To remedy this, the contractor added sheets of plywood to redirect the water back to the tank. Test instruments were crudely constructed and there was too much left to human error and interpretation. The test site was not well organized and there wasn't easy access to the instruments for verification of readings. Cooperation with government personnel was less than optimum.

Figure 1

Figure 2

Test Method

The test was conducted in a large tank with the pump mounted at one end. Attached to the impeller bowel was a straight section of 60” pipe followed by a 60” diameter, 90

degree elbow. The pump discharged from the elbow into the tank. Near the top of the discharge column, shown in Figure 2, was a hole for passing the pitot pipe into the discharge column flow. The pitot pipe was a long pipe, approximately 1" in diameter, capped on one end and with a hole in its side for measuring stagnation pressures. Attached to the other end of the pitot tube was a clear plastic tube which connected to a manometer constructed from a vertical aluminum "U" channel. The other end of the manometer was connected to measure undisturbed or static pressure. The difference between the stagnation pressure and undisturbed pressure was the dynamic pressure. The dynamic pressure was used to calculate the velocity at the location of the reading using the formula $h=V^2/2g$ where h was the dynamic pressure in feet, V is the fluid velocity in feet per second and g was the acceleration of gravity (32.2 feet/ second^2). Ten readings were taken across the pipe and later averaged to get the average velocity. From the cross sectional area of the discharge column, and the average velocity and the flow were calculated. The static head was determined later by measuring the stagnation pressure.

Accurate readings required stagnation pressure is read parallel to the pipe flow and undisturbed readings be made perpendicular to the velocity vector. Normally this is not a problem when the readings are taken 10 diameters away from any flow disturbance, a position where the velocity vector would be parallel to the pipe. In the case of the tests, the readings were being taken 1½ diameter from the pump impeller. In this region there was a high degree of turbulence from the impeller and the velocity vectors were not necessarily parallel to the discharge column.

The procedure I observed was to insert the pitot tube to a red mark painted on the pipe and then rotate the pitot in the flow to get the maximum difference between stagnation pressure and the undisturbed pressure. Done this way, the readings taken were not necessarily the velocity reading parallel to the discharge column. Also, the undisturbed reading may not have been taken without a velocity component. Prior to my arrival, Maria said the contractor was taking readings at estimated positions across the flow. She suggested they mark the pitot pipe so they could duplicate the reading and get more even spacing across the discharge column. The contractor complied with her request.

Other conditions which may have contributed to inaccurate test results were the test tank water, the unsteadiness of the water in the manometers, and use of a hand held tape measure for reading the manometer. The water in the test tank had debris from a recent fire and there was oil and froth in the water. See Figure 2. The water levels in the manometer moved around a lot making accurate reading and verification difficult. Two people were required to read the manometer; one would move the tape measure up and down trying to follow one leg of the manometer and the other would try to follow the moving water level in the opposite leg. The oil and debris in the tank may have affected the density and viscosity of the water and altered test results. After witnessing a test, I had a low confidence level in the accuracy of the tests.

I recommended dropping the pump performance tests and adding an endurance test for three main reasons. First, there was expected to be only slight variations in pump performance considering they were all manufactured to be identical. Secondly, I had a

low confidence level in the validity of the current performance tests and third we needed endurance testing to weed out mechanical problems before the pumps are shipped to New Orleans. MWI agreed to the change and we traded a performance test for a 5 hour endurance test. Later MWI claimed that the 5 hour test was adding too much testing time to their test scheduled and would impact delivery. The endurance test was then reduced to 3 hours with the stipulation that hydraulic pressures would be above 2500 psi for the duration of the tests.

Safety Issues

The test site had many safety hazards. Some as a result of a recent fire in which one person died and the test building was left without a roof. The accident occurred from weld splatter or sparks while supports were installed for two ten ton gantry hoists. The hoists would have made it easier to install the pumps into the tank. Sine they didn't have a gantry crane, the contractor had to use a mobile crane. The original job of installing gantry cranes was still in progress when I was there and there was always an awareness of people working overhead from man lifts. At one point, a sling fell into the test tank during a test and had to be retrieved by diving. Another hazard was the location of the HPU. In order to save time, the HPUs were left on a flat bed truck during the test. Access to the HPU was by portable stairs, but to get around while inspecting the various components required walking on oily surfaces with narrow ledges on both sides of the unit and hot surfaces everywhere. What I felt was a potential health hazard was the mist of oil laden test tank water given off during the test. Fortunately, for the 5 hour endurance tests, temperature readings were made every 30 minutes, allowing the inspectors to sit outside between readings.

A potential fire hazard existed with the HPUs. On two occasions a hose on the rear pump of one of the double vane pump sprang a leak. The leak developed from blistering on the hose's jacket near the fittings, followed by a high pressure fine mist spray of hot oil. The pump was manually shutdown before the condition developed further. The hoses were located between the rear of the engine and the hydraulic reservoir and fuel tank. They were near the engine exhaust turbochargers. The rupture I observed occurred on the bottom side of the hose. There was a potential for a rupture which would spray oil on the engine exhaust or turbochargers. Operating pressures on the pump discharge hoses were 3000 psi.

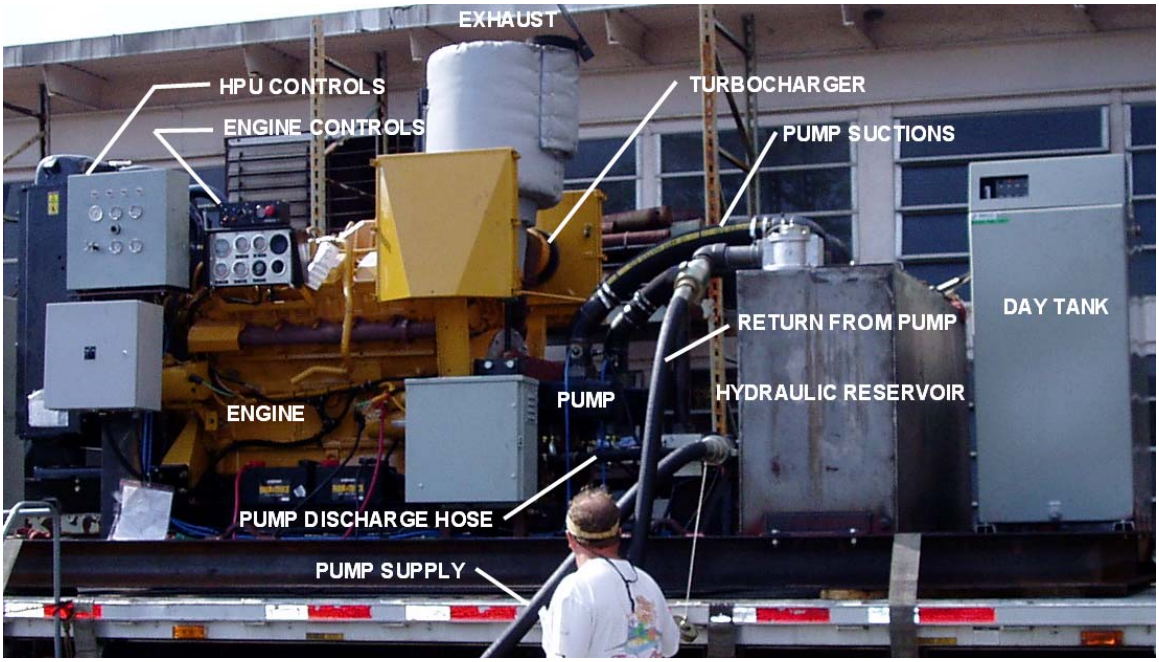

Figure 3

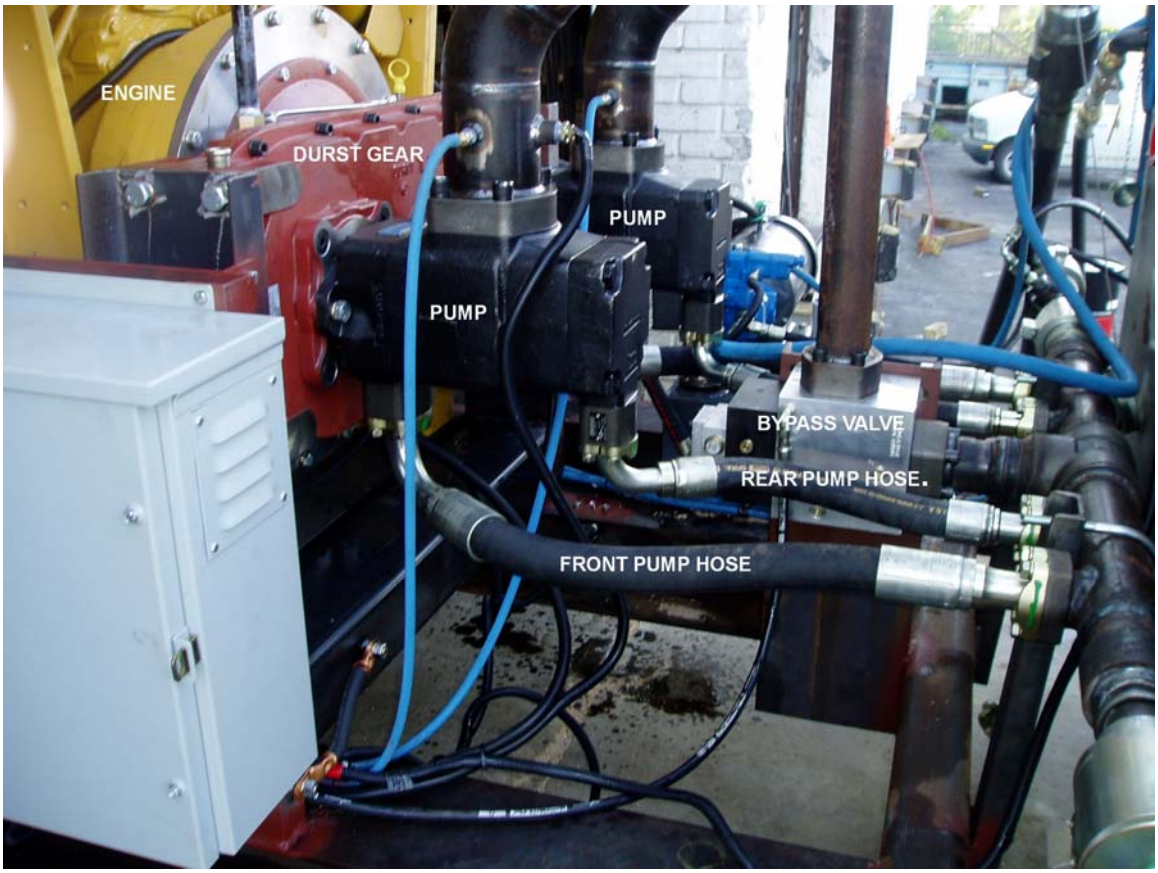

Figure 4

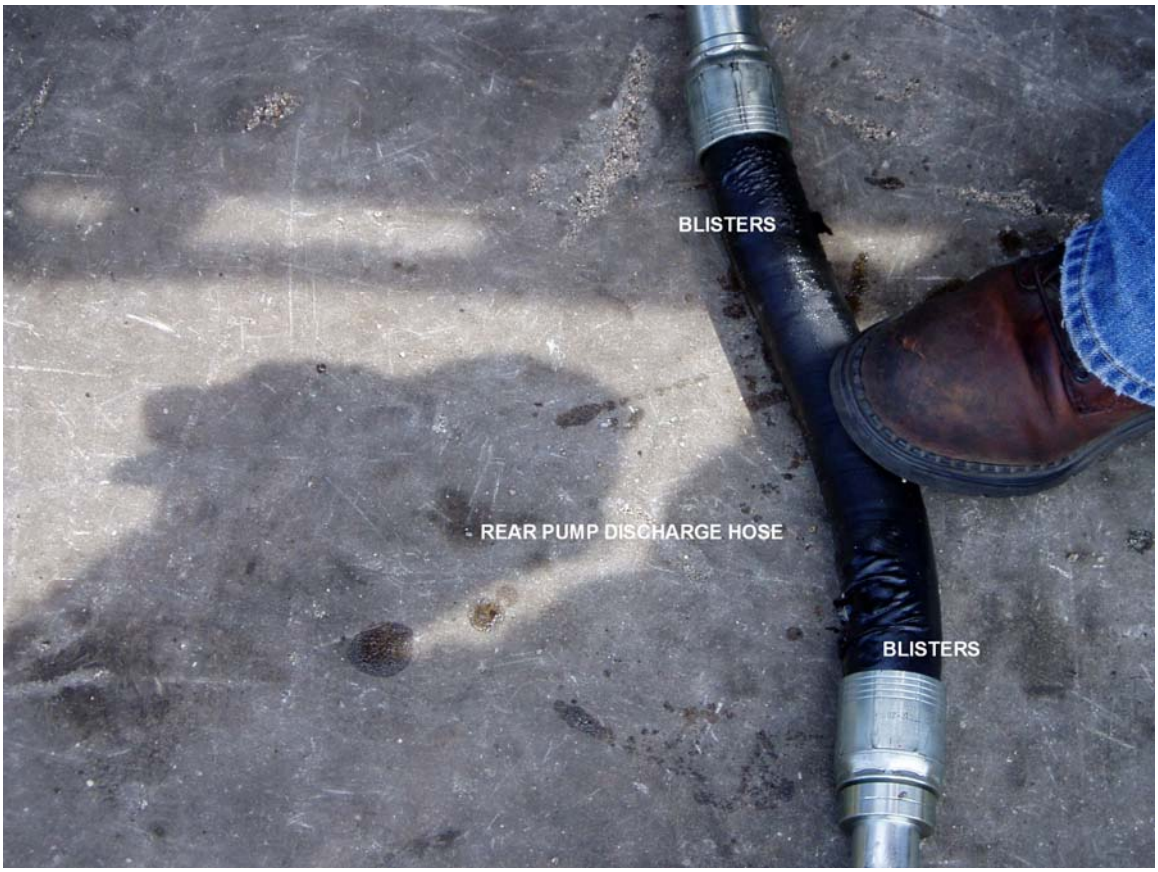

Figure 5

Recommendations:

1. The Corps should verify pump capacity with field testing. Because of the large clearance between impeller and impeller bowl of approximately ¼" and less than ideal test conditions at the factory, a field test on one pump should be conducted. Typically, impeller to impeller bowl clearance is on the order of 0.060" for a 60" pump.

2. A spray shield between the hydraulic system hoses and engine exhaust should be installed. In the event of a ruptured hose, a spray shield would prevent hydraulic fluid from spraying on the engine's hot exhaust.