Evaluating Oil Well Casing Corrosion Using Well Head Current Measurements

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ABSTRACT

Corrosion logs, carried out during previous investigations, indicated that severe corrosion was occurring on a significant number of oil well casings, located in the Arabian Gulf. The logs also indicated that the corrosion, occurring on the well casings being logged, increased substantially when certain electrical submersible pump (ESP) motors, located in adjacent wells, were activated.

An investigation was conducted to examine the possibility that the ESP motors, located at the lower extremities of their casings, were generating stray electrical currents. The investigation was focused on the measurement of electric currents flowing at the surface of the earth, assuming that any current flowing in the earth, at the ESP motor depth, would be reflected by a greatly reduced, but still measurable, amount of current flowing at the surface of the earth.

The measurements recorded during the investigation indicated that ESP motors, running under load, do not exhibit greater ground currents, unless one of the three power phases of the motors are shorted to ground. A substantial increase in ground current was noted on an ESP motor that also exhibited a phase to ground imbalance.

1. INTRODUCTION

Corrosion logging is an accepted method for determining the integrity of oil well casings. During a previous investigation, corrosion logs indicated that severe corrosion was occurring on a significant number of oil well casings, located in the Arabian Gulf. The logs also indicated that the corrosion, occurring on the well casings being logged, increased substantially (Figure 1) when some ESP motors, located inside adjacent well casings, were activated.

It was suspected that the adjacent ESP motors, located at the lower extremities of their casings, were generating stray electrical currents (Figure 2), and that the stray currents, in turn, were effecting the surrounding casings. An investigation was conducted in order to determine what factors, if any were causing the ESP motors to generate stray currents.

The investigation was focused on the measurement of electric currents flowing at the surface of the earth, in the vicinity of the well head containing the ESP motor being investigated. It was assumed that any current flowing in the earth, at the ESP motor depth, would be reflected by a greatly reduced, but still measurable, amount of current flowing at the surface of the earth.

2. DATA

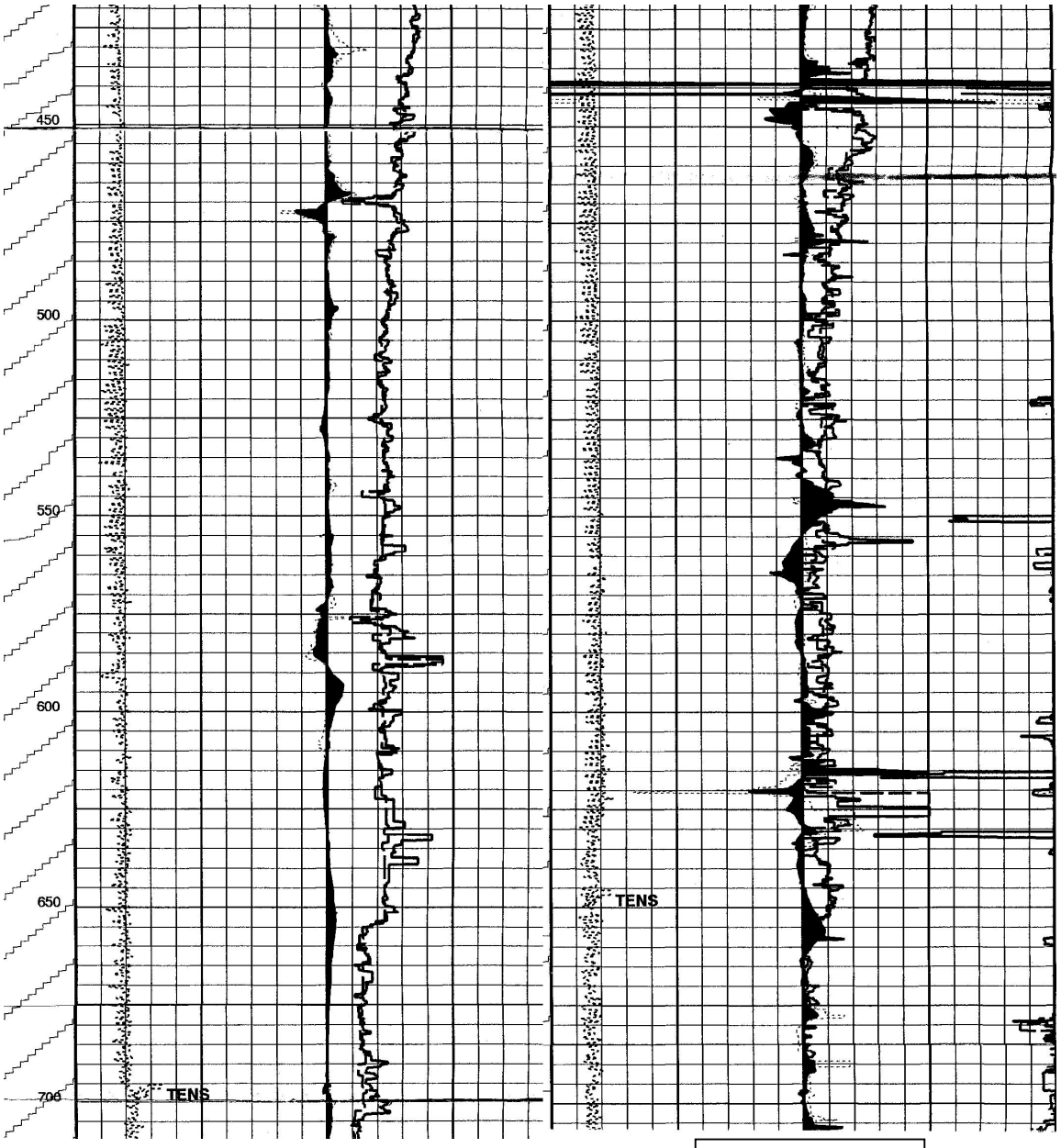
Two current measurements were recorded on a portable oscilloscope, for each ESP tested. One ground current was recorded with the ESP motor turned off and one with the ESP motor operating under normal load. The two upper traces depicted on Figure 3 indicate that there was very little difference in the amount of current flowing on the surface of the ground when the ESP motor No. 116 was turned off or when it was operating at normal load. Essentially the same traces were obtained for ESP motor Nos. 042, 054, 061, 072, 088, 112, and 113. Each of the eight ESP motors depicted on the upper traces of Figure 3 were also measured for phase to ground faults. None of the eight motors exhibited phase to ground faults.

The two lower traces depicted on Figure 3 indicate that there was more than a four fold increase in the magnitude of the AC current flowing at the surface of the soil when ESP motor No. 092 was turned on and operated at normal load. When tested, ESP motor No. 092 was found to have a significant phase to ground fault.

3. SUMMARY

The recorded measurements indicated that ESP motors running under normal load do not exhibit greater ground currents than when the motors are turned off, unless one of the three power phases of the motors are shorted to ground. A substantial increase in ground currents was noted on an ESP motor with a phase to ground imbalance.

Motors with one power phase shorted to ground will continue to operate and produce oil. However, the benefits of allowing a motor with a phase to ground imbalance to continue to operate, must be evaluated against the substantial cost of repairing or replacing the ESP motor housing and the surrounding well casings.



CASING 015 – CORROSION LOG

FIGURE 1

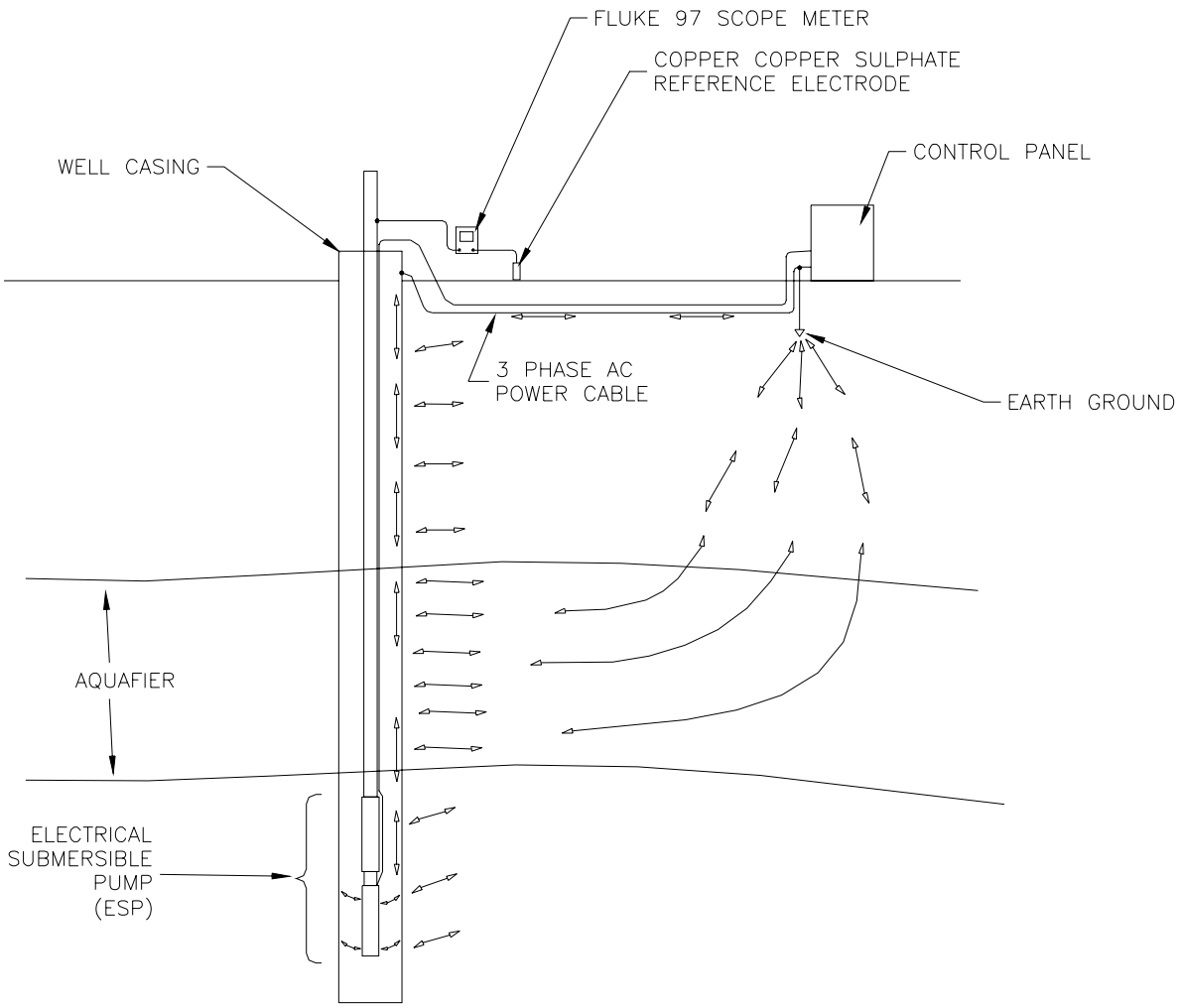
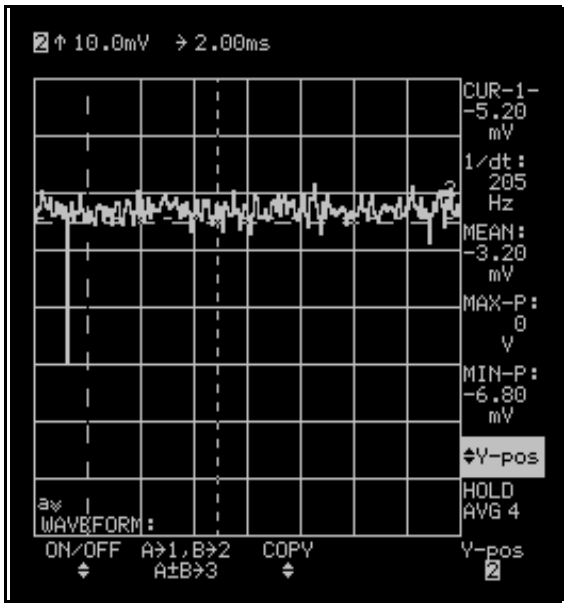
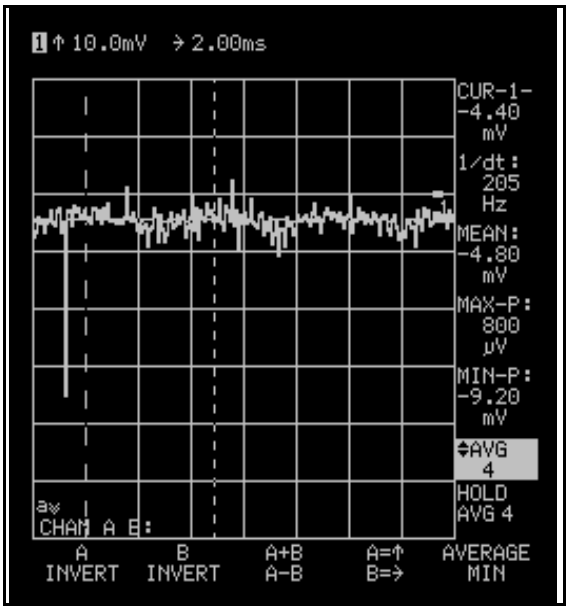

FLUKE 97 SCOPE METER
COPPER COPPER SULPHATE
REFERENCE ELECTRODE
CONTROL PANEL
WELL CASING
3 PHASE AC
POWER CABLE
EARTH GROUND
AQUAFIER
ELECTRICAL
SUBMERSIBLE
PUMP
(ESP)

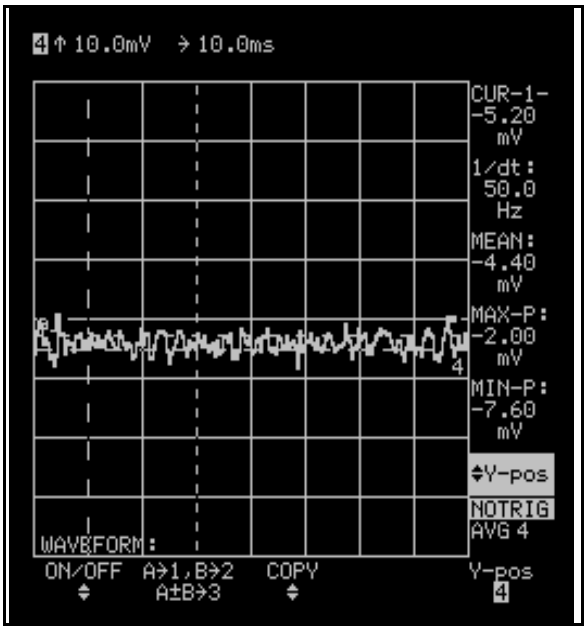
FIGURE 2



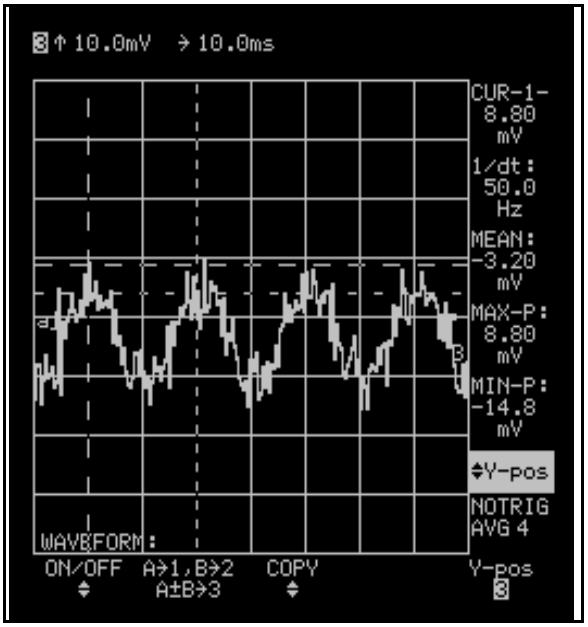
042,054,061,072,088,112,113,116
MOTOR OFF



042,054,061,072,088,112,113,116
MOTOR ON



092 MOTOR OFF



092 MOTOR ON

FIGURE 3