Protecting Semi-Close Spaced Oil Well Casings With Multi-Module Pulse Cathodic Protection

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ABSTRACT

Protecting close-spaced oil well casings was next to impossible until the advent of Pulse Cathodic Protection. Any attempt to protect any one or a group of close-spaced wells with conventional cathodic protection invariably resulted in damage or unpredictable current flow to the other wells in the group. Two benefits, derived with the use of Pulse Cathodic Protection, are the near absence of interference on adjacent buried structures, and the more even redistribution of the protective current during the pulse off period.

When casings are semi-close spaced, however the off period current will become redistributed mainly from more to less protected areas of the same casing. With greater separation between casings, less current will be redistributed evenly between each of the casings in the group.

The problems associated with cathodically protecting a group of semi-close oil well casings have been resolved with the recent development of Multi-Module Pulse Cathodic Protection Systems. Semi-close spaced oil well casings located in the Arabian Gulf are currently being successfully protected with the new Multi-Module systems.

1. INTRODUCTION

Until the advent of Pulse Cathodic Protection (PCP) (4.1), it was not possible to protect close-spaced oil well casings with conventional cathodic protection (CCP). Even if it were possible to control the flow of CCP current to each of the well casings in a group, it was not possible to prevent the continuously flowing CCP current from exiting one casing and traveling to an adjacent casing (4.2). Any CCP current, continuously exiting a casing surface, will invariably cause interference damage to the casing surface, at the point of exit.

The PCP systems, in contrast, produce a series of very short duration, very high voltage, direct current pulses, between the multiple structure being protected and the anode bed. The very short duration PCP pulses are separated by relatively long “off” intervals. The PCP voltage is applied for less than 10% of the total time. Thus, the continuous CCP current, and the resulting interference on the adjacent casings in the group, is greatly reduced. The two main benefits, derived with the use of PCP, are a near absence of interference on adjacent casings and other structures, and the redistribution of the protective current during the pulse “off” period.

The benefits of current redistribution include the ability to protect a number of close-spaced well casings with one PCP system and one anode bed. Current from a more protected casing, or portion of casing, becomes redistributed to less protected casings, or to less protected areas of the same casing, during the "off" period of the pulse.

When the casings are semi-close spaced, the "off" period current will become redistributed from more to less protected areas of the same casing. However, if there is any appreciable distance between the casings, the current is not likely to become redistributed from one casing to adjacent casings. It is not possible to supply each of the semi-close spaced casings with the amount of current necessary for protection, from a single anode bed and PCP system. Because of interference effects CCP, is also not an alternative for protecting oil well casings that are semi-close spaced.

The problem of protecting semi-close spaced oil well casings was recently resolved with the development of the Multi-Module Pulse Cathodic Protection (MM-PCP) system. Each MM-PCP system contains multiple, but separate, PCP modules (Figure 1). Each module supplies pulse current to a separate well casing from a single anode bed (Figure 2).

The pulse current output for each well casing can be controlled independently from the pulse currents supplied to the other well casings in the semi-close spaced group. The well head potential, as measured against a reference electrode, can be set to a desired level for each well casing, by independently adjusting the pulse current flowing to that particular casing.

2. DATA

DATE	WELL 010		WELL 015		WELL 100			WELL 008		WELL 050		WELL 089	
	mV	Amps	mV	Amps	mV	Amps		mV	Amps	mV	Amps	mV	Amps
08-Jul-97	670	0.0	565	0.0	610	0.0		525	0.0	670	0.0	525	0.0
16-Oct-99	743	5.0	690	6.8	690	10.5		617	5.1	768	6.0	635	6.0
21-Oct-99	833	5.0	694	6.8	696	10.5		625	5.0	782	6.1	644	6.1
29-Jun-00	861	2.8	834	3.5	672	10.1		659	9.0	792	4.5	695	7.2

The data obtained on two groups of well casings located in the Arabian Peninsula, each group being protected by a separate MM-PCP system, are presented above. The data includes well-head Pipe-to-Soil MilliVolt (mV) potentials obtained using a CuCuSO4 reference electrode. The data also includes pulse current measurements in amperes (Amps) for each well in each of the two groups.

The readings were recorded on four separate days. The first set of readings, dated 08 July 1997, was recorded before current was applied by either of the two MM-PCP systems. These readings represent the native state potentials for each well casing.

The data indicates that the well casings in each group showed a significant increase in potential, over native state, when the two MM-PCP systems were first activated on 16 October 1999. It

should also be noted that certain well casings such as 010, 015, and 050 are polarizing at a faster rate than the other casings. The rate of polarization is very likely related to such factors as electrical interconnections to other buried structures, total surface area exposed, and corrosivity of the soils in contact with the outer surfaces of the casings.

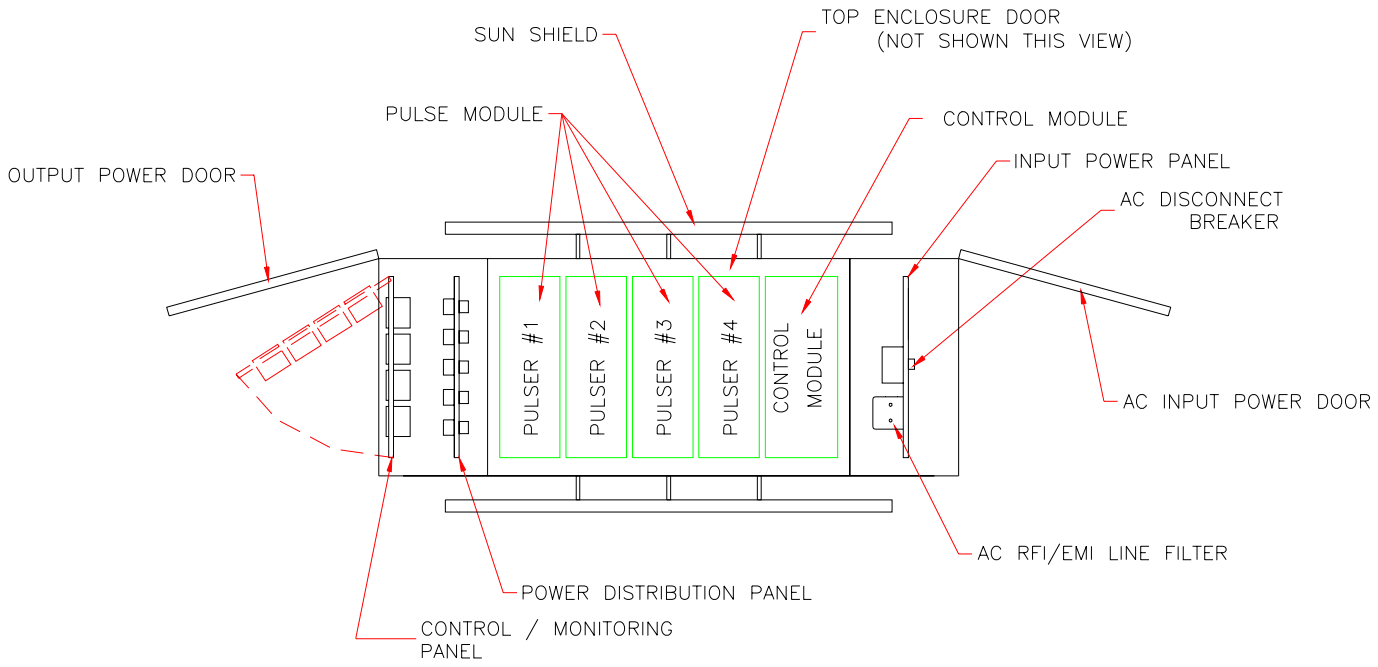
3. SUMMARY

Close-spaced groups of oil well casings were very difficult to protect until the development of PCP systems. Individual PCP systems, however offer only a marginal means for protecting semi-close spaced groups of well casings, which are very common in the Arabian Peninsula. The problems associated with protecting semi-close spaced well casings have been successfully addressed with the development of Multi-Module PCP systems. The MM-PCP systems provide a means for controlling the pulse current individually to each well casing.

4. REFERENCES

4.1 Doniguian, T.M., “Pulse Rectifier Improves Cathodic Protection”, American Gas Association Transmission Conference, Palmer House, Chicago, Ill, May 17-19, 1982.

4.2 Schremp, F.W., “Distribution of Protection and Interference Currents of Oil Well Casings.” NACE Western States Corrosion Seminar, 1969.



MULTI–MODULE PCP SYSTEM
(PLAN VIEW)

FIGURE 1

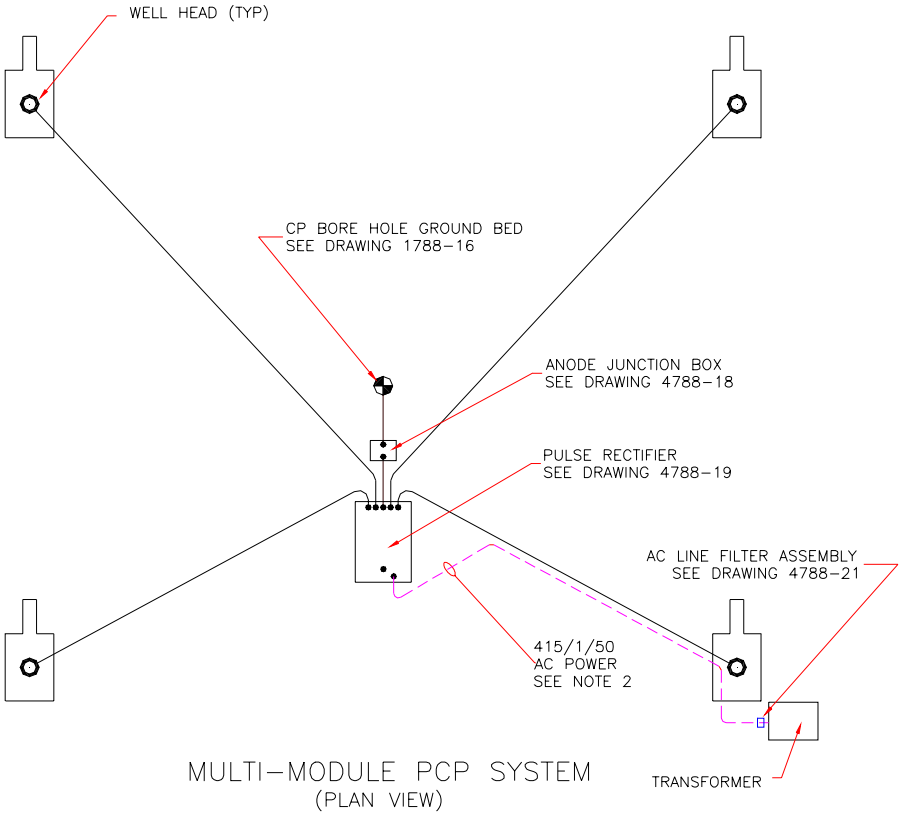

WELL HEAD (TYP)
CP BORE HOLE GROUND BED
SEE DRAWING 1788-16
ANODE JUNCTION BOX
SEE DRAWING 4788-18
PULSE RECTIFIER
SEE DRAWING 4788-19
AC LINE FILTER ASSEMBLY
SEE DRAWING 4788-21
415/1/50
AC POWER
SEE NOTE 2
TRANSFORMER
MULTI-MODULE PCP SYSTEM
(PLAN VIEW)

FIGURE 2