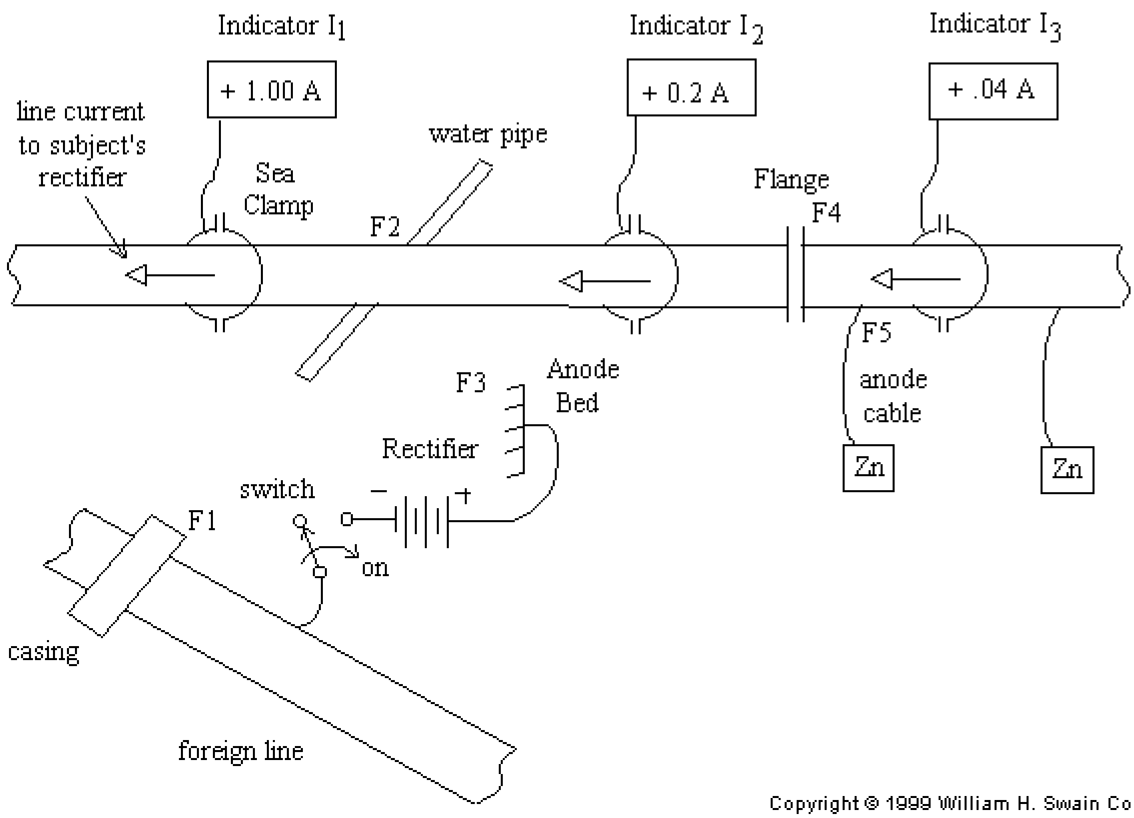
Line Current Monitor

This paper relates to knowing of an electrical contact with a foreign line, when contact occurred, and a lot more. Inferred CP potential can now be monitored over a considerable length of line by measurement of actual line current. This is best done with two or more well spaced Amp Clamps permanently installed and buried with the line. An illustration is in Fig. 1.

(One of our customers has permanently installed Amp Clamps six feet below ground to measure interference current flowing in a gas pipeline.)

Fig. 1

Subject Pipeline buried with Amp Clamps set to measure normal CP current

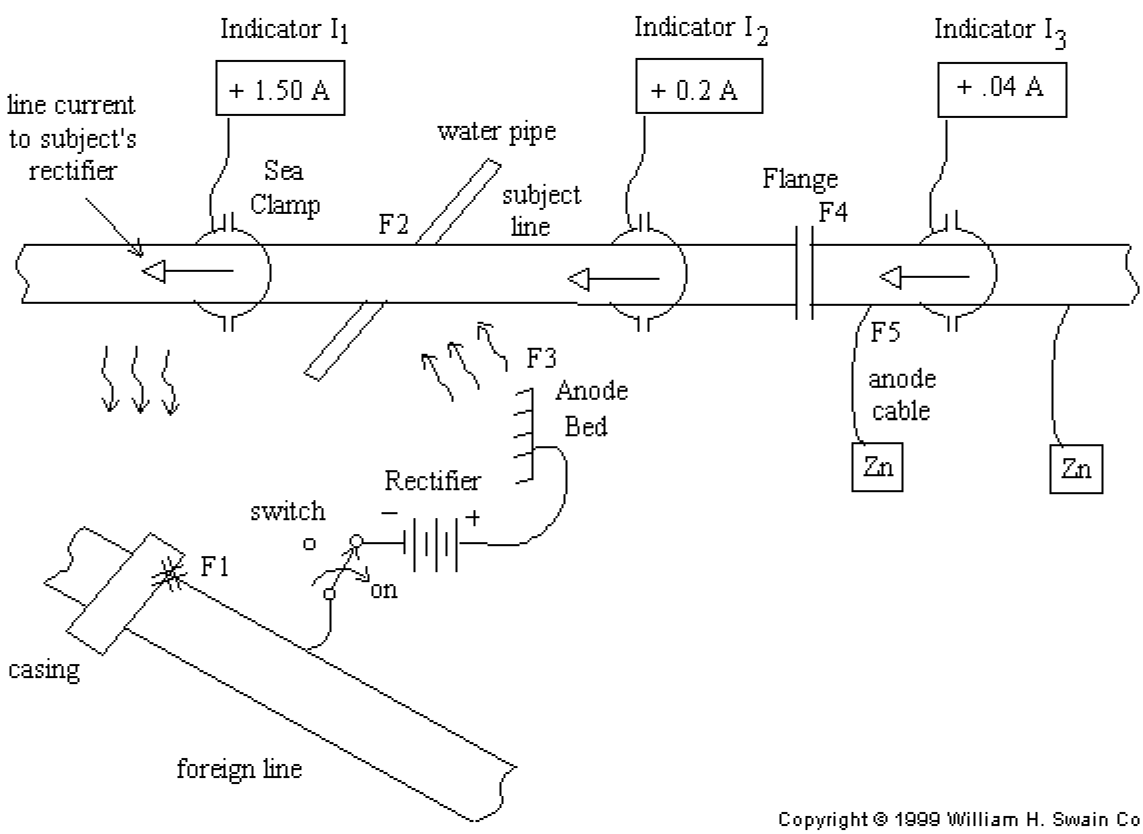


A suitable Line current monitor is sensitive to a definite contact with a foreign line. Moreover, it shows interference current from a foreign line through soil or water, as well as ground bed current from a newly activated foreign rectifier. Even a flange fault on subject line or a broken cable to a sacrificial anode will show up in a line current monitor. Moreover, with 1 milliamp resolution, there is no need to wait for a complete failure. Early warning of incipient failure can be available.

Fig. 1 illustrates subject buried pipeline with 3 well spaced clamps permanently installed. The CP potentials were within acceptable limits when the above ground indicators I_1, I_2, and I_3 showed 1 Amp, .2 Amp, and .04 Amp respectively. This is called the "normal" state.

Currents are indicated as positive because the direction of current flow is with the polarity arrow marked on the clamp.

Fig. 2
Subject pipeline with CP current faults F1 & F3



In the illustration Fig. 2, an adjacent foreign pipeline (not in definite contact) experiences a line to bare casing short (F1) at about the time the foreign rectifier is switched on. New foreign anode bed (F3) is only 100 ft. from subject line which has adjacent coating defects, so ½ Amp or so can enter subject line at F3, and leave near the casing F1.

This fault condition changes the reading of indicator I_1, from + 1 A to + 1.5 A. It represents a big change in CP current in the 1 mile line sector covered by monitor I_1.

Inserting an AC indicator on clamp I_1 will likely show a positive going rectified 60 Hz AC waveform, or perhaps positive going pulses from a wide throw rectifier. This is a tip off pointing to an anode bed.

Since a substantial upset of CP potential is evident, the user will likely soon look the area over with a view to getting the faults cleared, or compensating for their presence.

Fig. 3
Subject Pipeline with CP Current fault F2

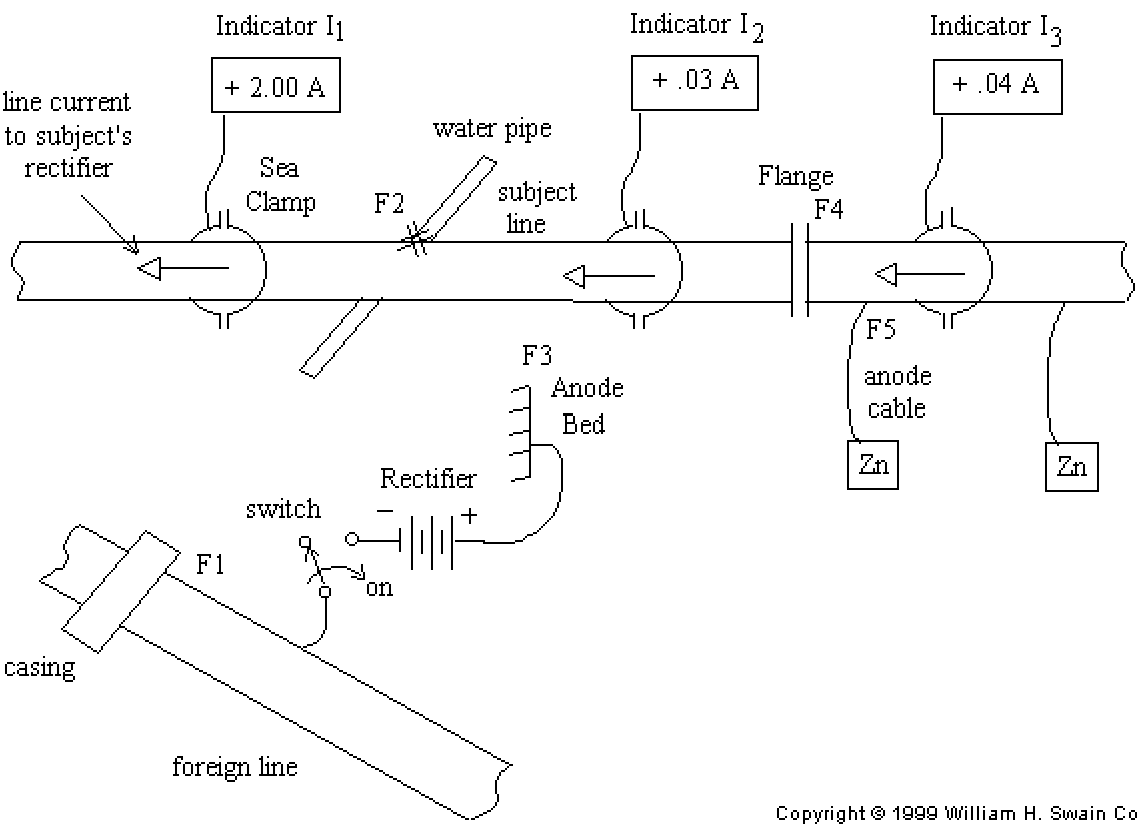


Fig. 3 illustrates a definite contact fault (F2) of the sort located by Mr. Joe Maxwell. The CP current monitor notifies the user that indicator I1 measures double normal current because the bare water pipe is soaking up most of the available current.

If an AC indicator and 'scope are connected to clamp 1, it will likely show a strong power line current at 60 Hz (in USA) because water pipe is often AC ground. This is a hint for the search party.

Fig. 4
Subject Pipeline with CP Current fault F4

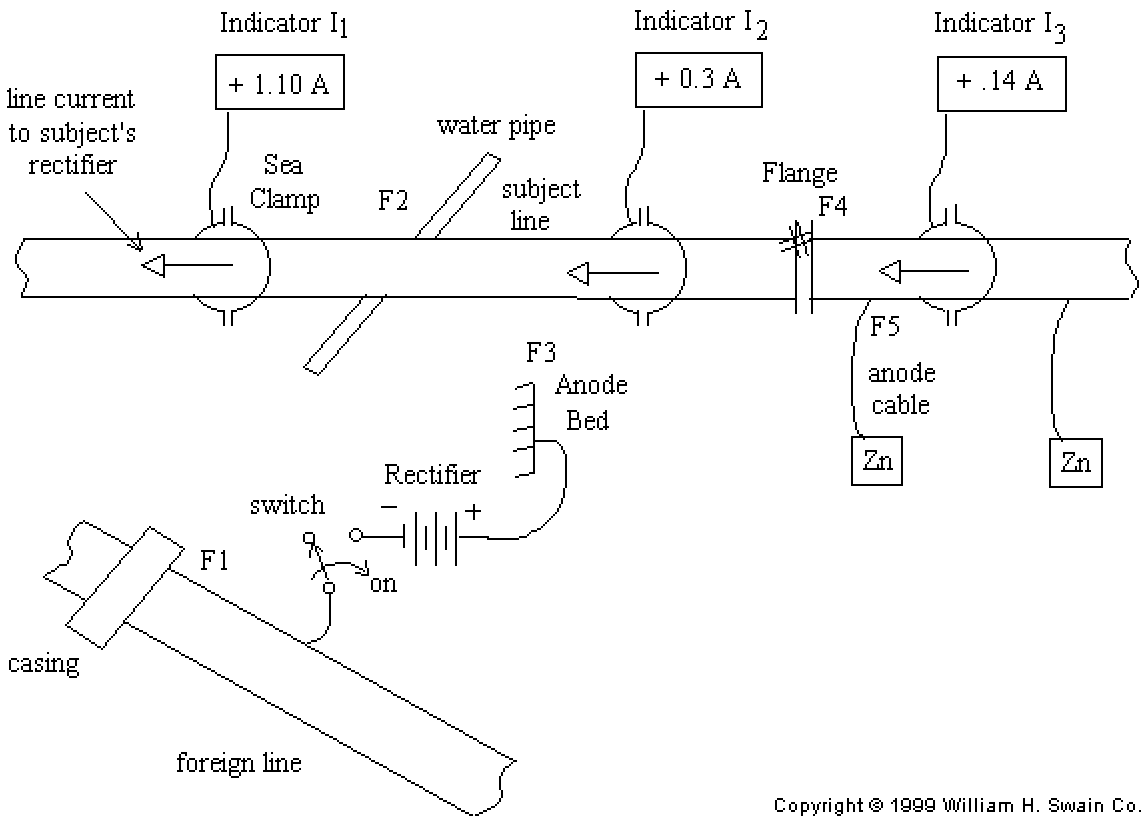


Fig. 4 illustrates and insulating flange faulted short. The subject rectifier off to the left now pulls an extra 0.1 Amp from the zinc anode protected line sector. This increases I_1 from 1.0 to 1.1 Amp; I_2 from 0.2 to 0.3 Amp; and I_3 from .04 to .14 Amp.

Search is aided by seeing that the .1 Amp increase occurs on both sides of the flange. Moreover, I_3 now shows positive going AC 60 Hz rectifier waveform when an AC indicator and oscilloscope are used. Previously, in the normal state of Fig. 1, I_3 was nearly pure DC plus ground noise, which is characteristic of zinc anodes in a right of way.

Fig. 5
Subject Pipeline with CP Current fault F5

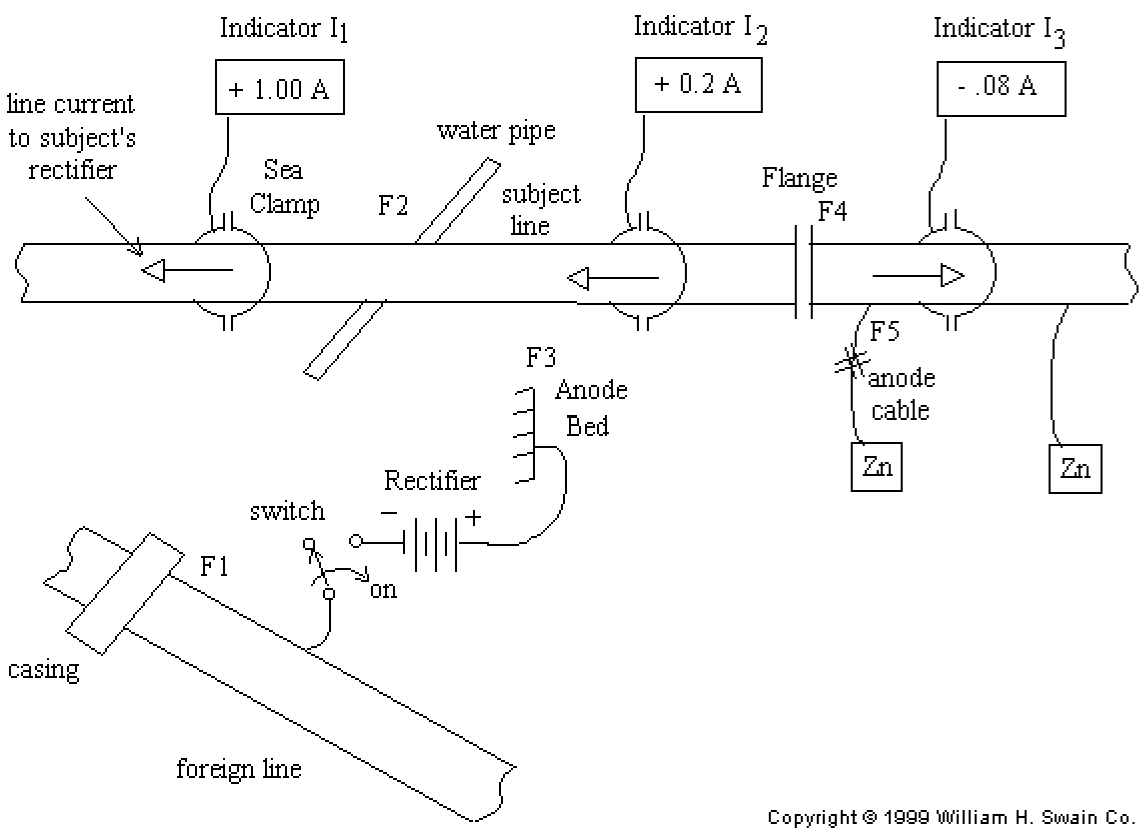


Fig. 5 illustrates a cut anode cable and its effect on line current. Indicator I3 displays reversed polarity at double magnitude. This is understandable when we note that in the normal state, I_3 showed near zero current because the zinc anodes on the isolated line sector pretty well shared the load. On the other hand, with the anode cable cut at F5, all current must go to the right hand anode.

Fault location is aided when we see a change in only I_3. The problem should be to the right of the insulated flange.

Which anode lead is cut is signaled by the polarity of I_3. More current is being drawn to the right, so the right hand zinc appears to be working. Check the left zinc.

AC scope readings will show slightly noisy DC. The problem is likely associated with sacrificial anodes.

Conclusion:

Buried Amp Clamps are reliable. They have been tested for at least 2 years either buried on a 30 inch pipeline or in a salt water container. We are pleased to find less than 2% gain loss. The change in zero offset is less than half the H_e specification.

A line current monitor can be built to show that CP potentials are likely within tolerance, or not. If a pipeline fault occurs, this will also show when it happened, about where it is, and its nature.