Case Scenario: **Electrocution on a Paper Cutting Press Due to Poor Grounding**

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Expert's Job Assignment: To analyze the cause of the death for the Insurance Company

Case Synopsis

The accident happened during a maintenance operation. The deceased was replacing the dies on a paper cutting machine, called a "Press" in this case. The press was designed to cut heavy paperboard into the proper shapes for further processing. He reached into the press below the die area for a dropped screw or nut with his left hand when his right calf came into contact with the exit conveyor frame. Evidently there was a source of voltage that had energized the conveyor frame, thus causing his death.

Expert Analysis

1. The factory electrical supply feed was from an incoming 480 volt three phase system. It had a ground fault protective feature on the incoming lines. The press and the conveyor are fed from a grounded three phase delta-delta step-down transformer. In the switch for the press the center phase read 0.4 volts to ground; the other two read 240 volts to ground. The drain valve on an air line adjacent to the switch was used as the ground reference.
2. When I visited the location I could find no electrical fault concerned with the press itself. The 240 volt, 3 phase grounded delta feed to it was reported to have been shut off when the accident occurred. With power off to the press I found no voltage to ground anywhere on it. Also the ohms to ground from the press measured to be 0.075 ohms.
3. Prior to the accident the conveyor was grounded by being connected to a driven "ground rod" located at the exit end of the conveyor. After the accident the maintenance man had run a bare stranded wire from the frame of the conveyor to the base of the press. This gave the conveyor a good ground through the press to the building steel. Measurements taken by me with this added ground wire disconnected showed that the "ground rod" had about 90 ohms to the building steel framework. Thus at the time of the accident the conveyor had not been effectively grounded.
4. If the conveyor had been energized at 120 volts, with a ground as poor as what I measured it to be, the current drain would have been small. Using $I = V/R$, at 90 ohms ground resistance the current would have been about 1.33 amps. This would not trip a 15 amp circuit breaker, thus the conveyor frame would not have been de-energized automatically. I saw no evidence anywhere on the conveyor structure of any electrical fault.
5. The main method of grounding the press was through the green wire of a 4-wire flex cable that feeds into the contactor box on top of the press. This ground wire was there at the time of the accident. After the accident the maintenance man had installed a ground to the inside of the disconnect switch for the press. Both of these ground wires get their grounding from being bolted to the inside of the junction box in the truss area where the flex cable is connected to feed the press. Thus they are tied electrically to the building steel, as was one leg of the 240 volt delta transformer secondary.
6. Since much repair and re-circuiting had been done since the accident, one could ask if anything has been hidden. I don't believe that, since the maintenance man seemed to be open and honest, and what he had done seemed to be in the best interest of good electrical practice.

7. I could find no evidence of leakage voltage to either the conveyor or the press. At the time of the accident it was reported that the press switch was in the "Off" position. The conveyor was not running.

Expert Opinion

1. At the time of the accident the press was solidly and effectively grounded and the exit conveyor was not, since it was connected to a ground rod that had high resistance to the building and electrical system ground.
2. The exit conveyor must have been energized by some electrical connection through faulty wiring of some nature. As noted above, since the resistance to ground was as high as it was, the ground current was not high enough to trip a normal circuit breaker that was rated at 15 amps. There were no "ground fault interrupter" type circuit breakers on the 240 volt side of the step-down transformer.
3. I felt that the major contributor to the accident was the improper grounding of the conveyor frame. Had it been properly grounded, then whatever caused the frame to be energized would have created a short that would have tripped the supply circuit protective device, thus removing the dangerous condition.
4. Using a driven ground rod instead of connection the equipment to the building framework as the machinery ground was the basic mistake made. All grounding systems must be effectively bonded together in order to achieve the electrical safety that all codes require.