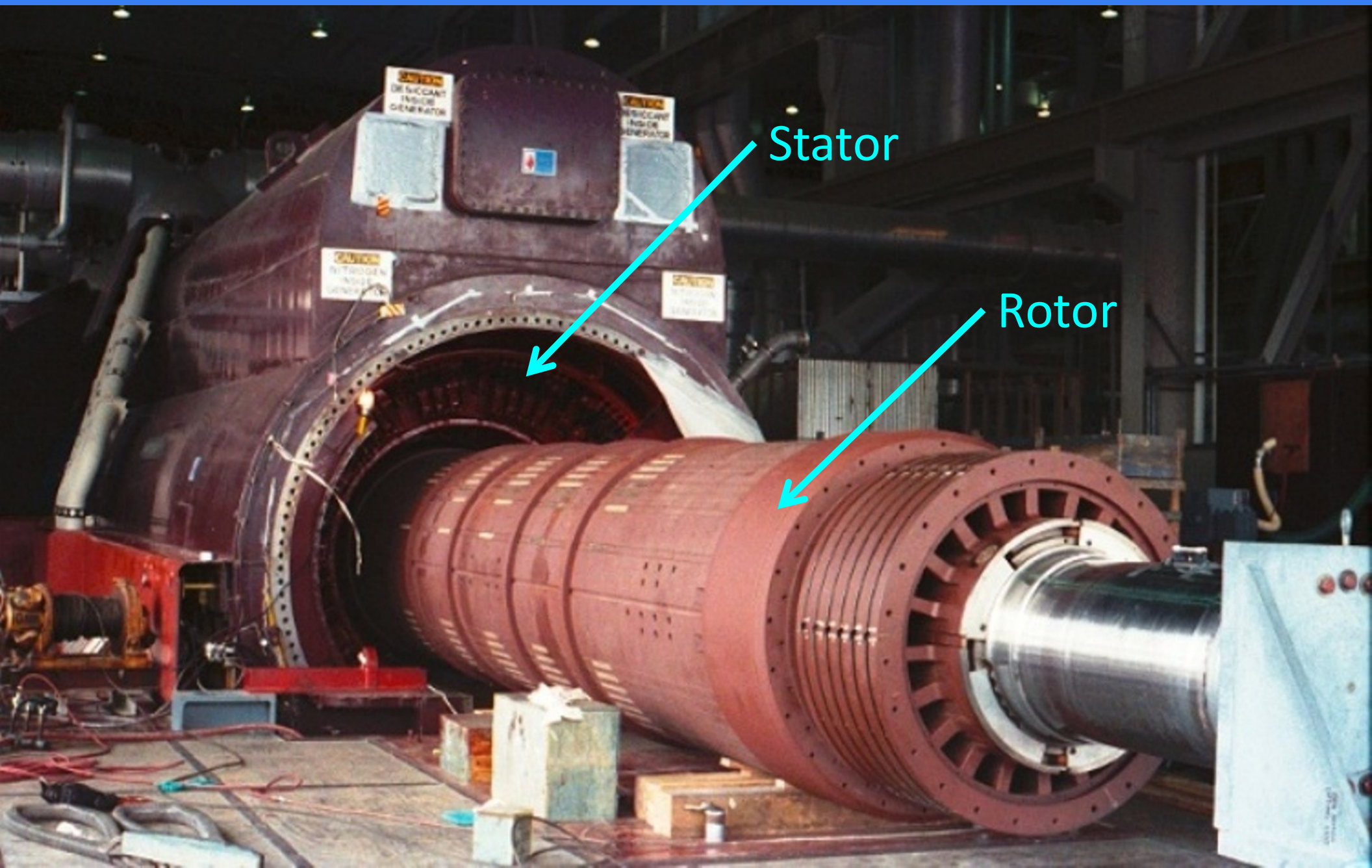
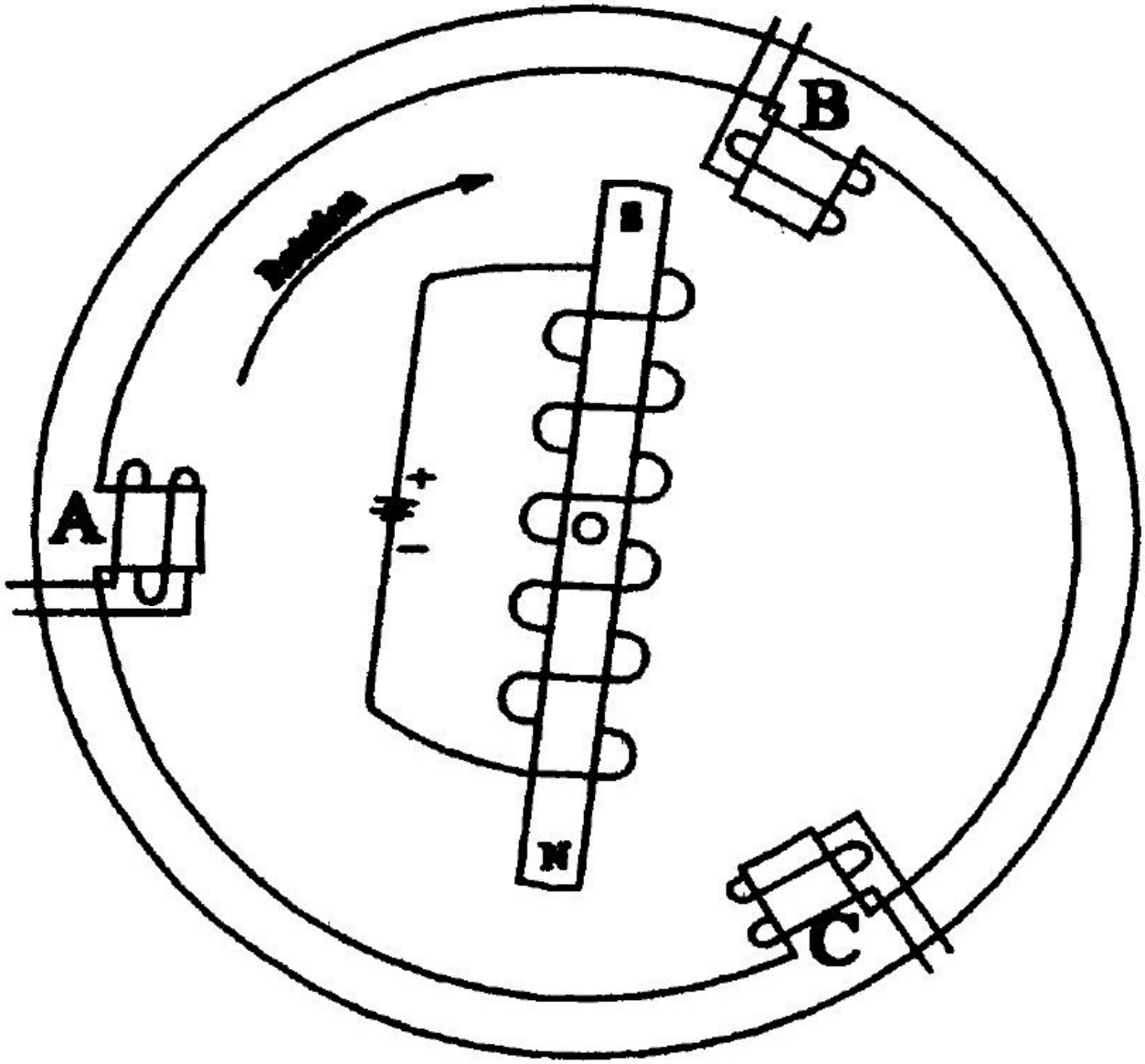
Backgrounder: Three Phase Power

Most alternating current (ac) generators produce three phase electricity. Nuclear power plant main generators consist of a rotor within a stator. Like a hand-crank flashlight or radio, the spinning rotor generates electrical power.



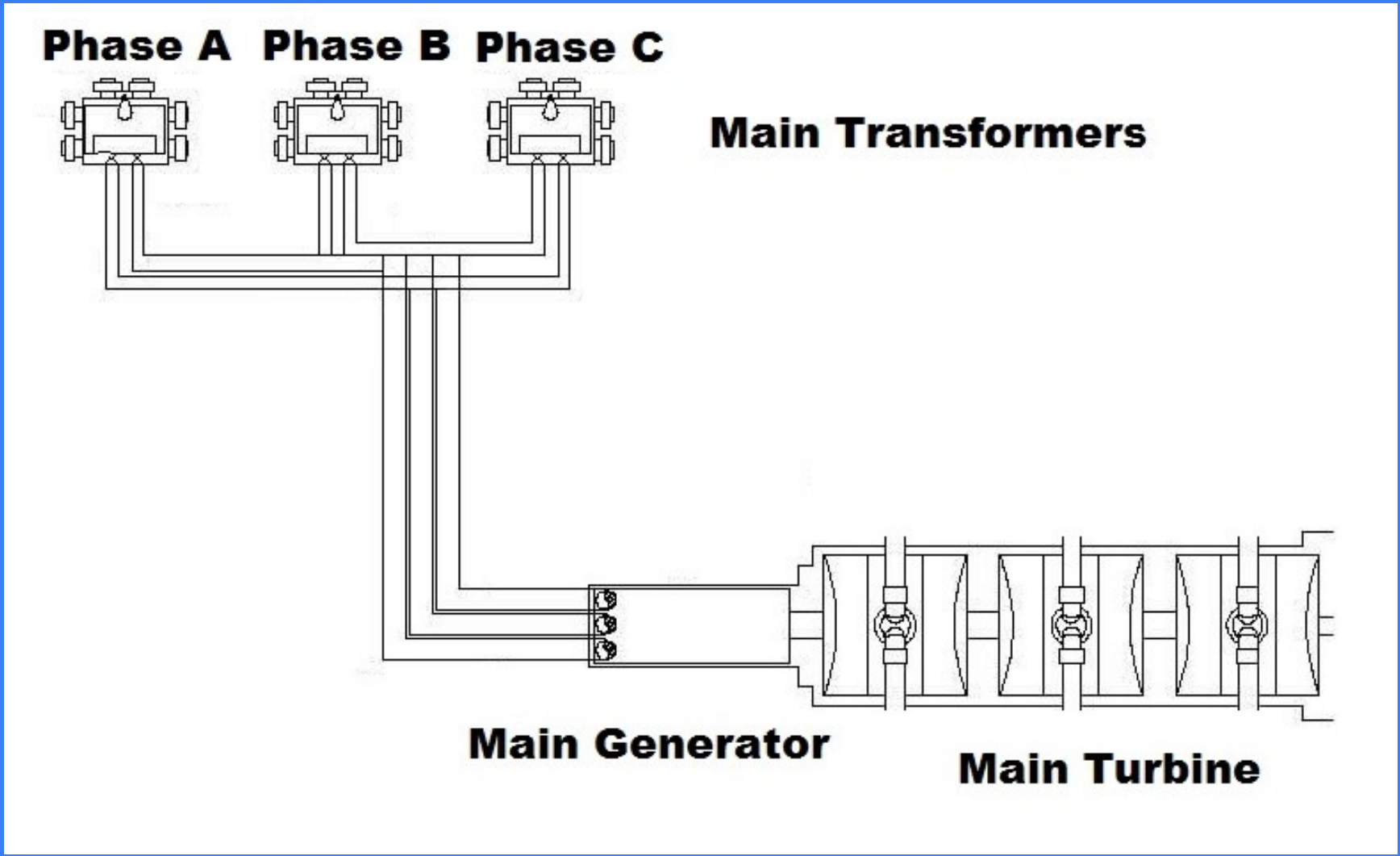


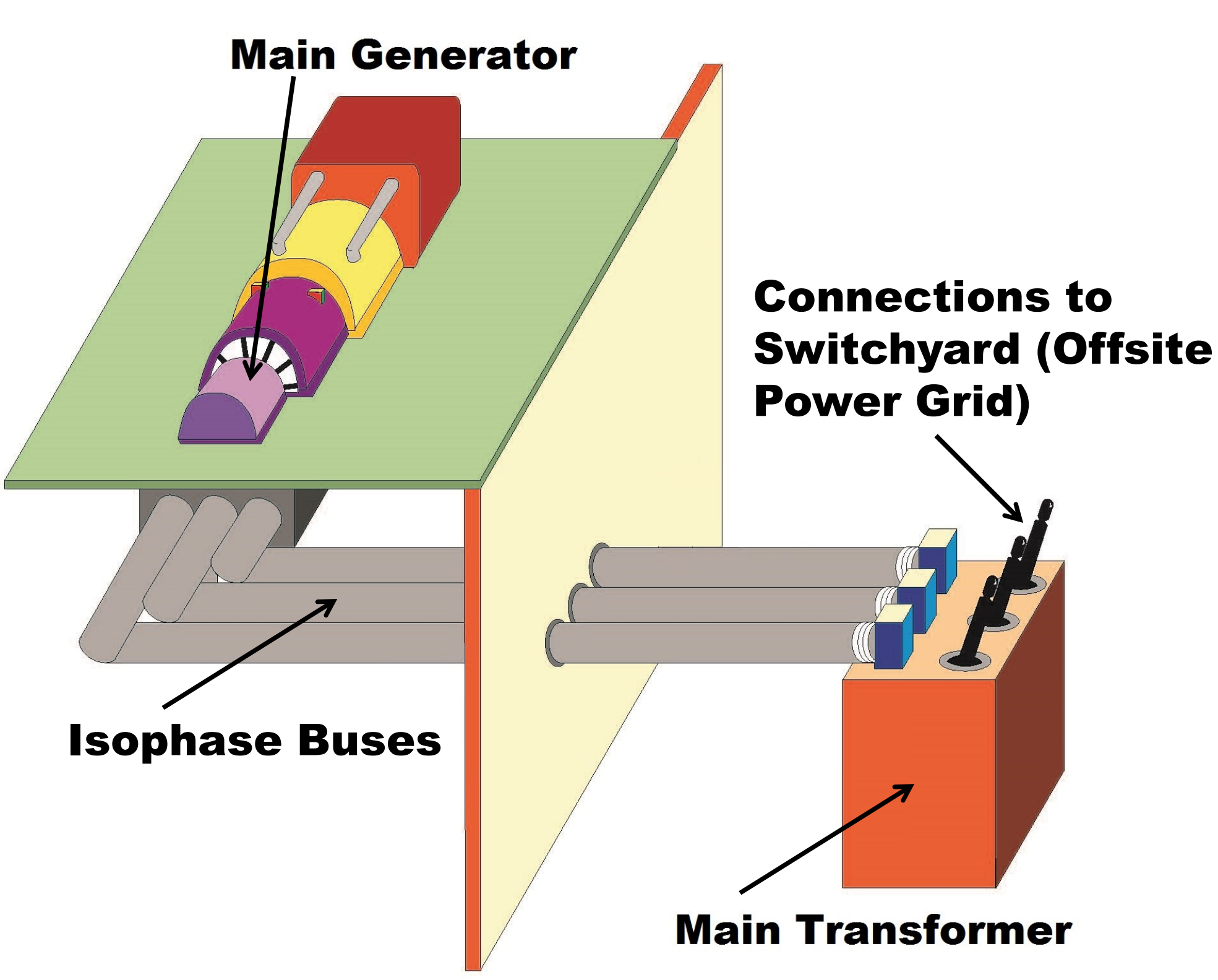
Simplified 3 Phase AC Generator

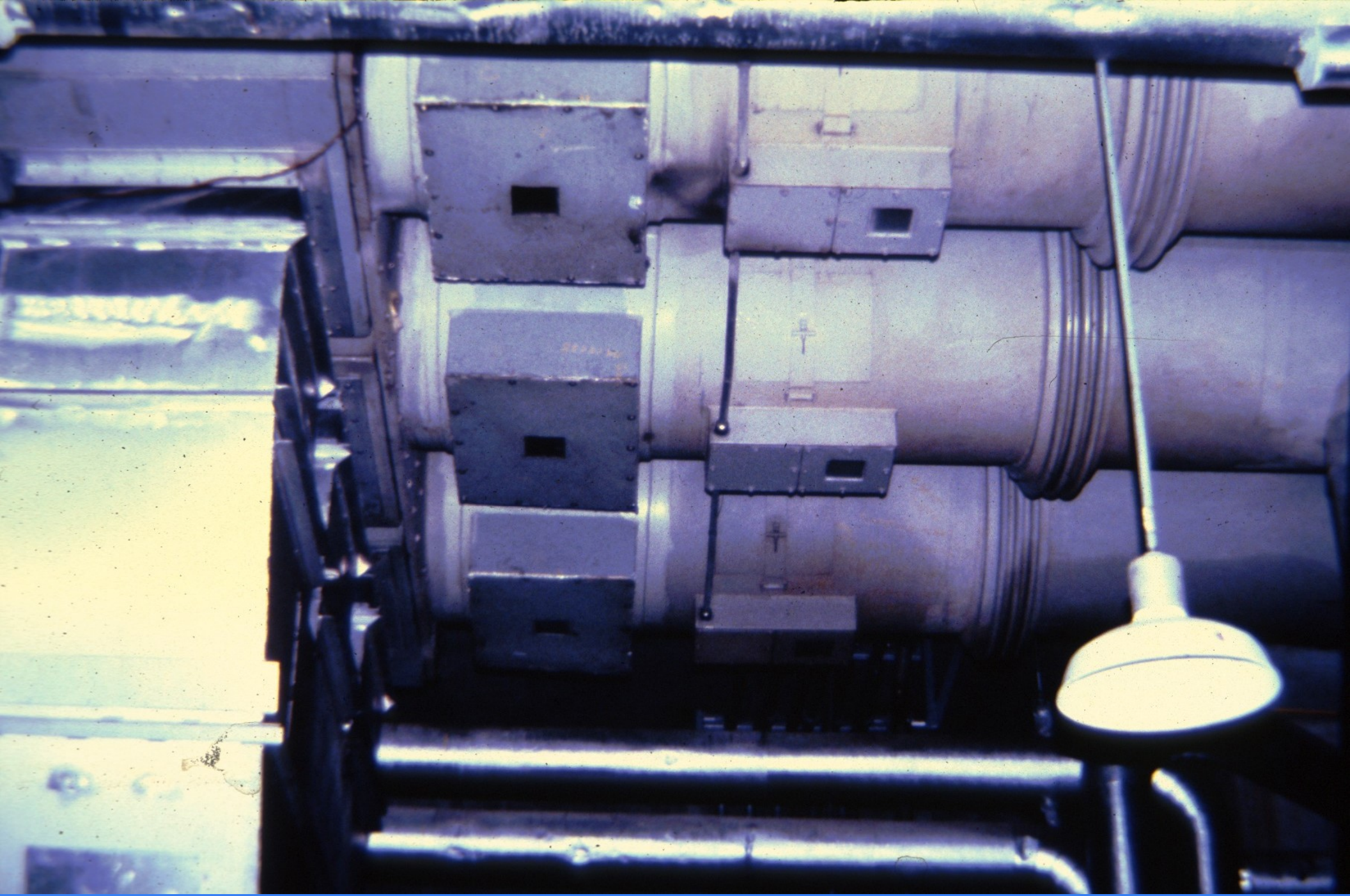
Three-phase generators are more economical (i.e., cheaper) than single-phase generators.

This view looks at one end of a rotor within a stator. This rotor spins clockwise past coils for the three phases (A, B and C), installed 120 degrees apart. This configuration minimizes the stress on the rotor, enabling it to be made from less robust material.

Each phase of power is routed from a nuclear plant's main generators to the main transformers via individual links called isophase buses (i.e., single phase buses.)



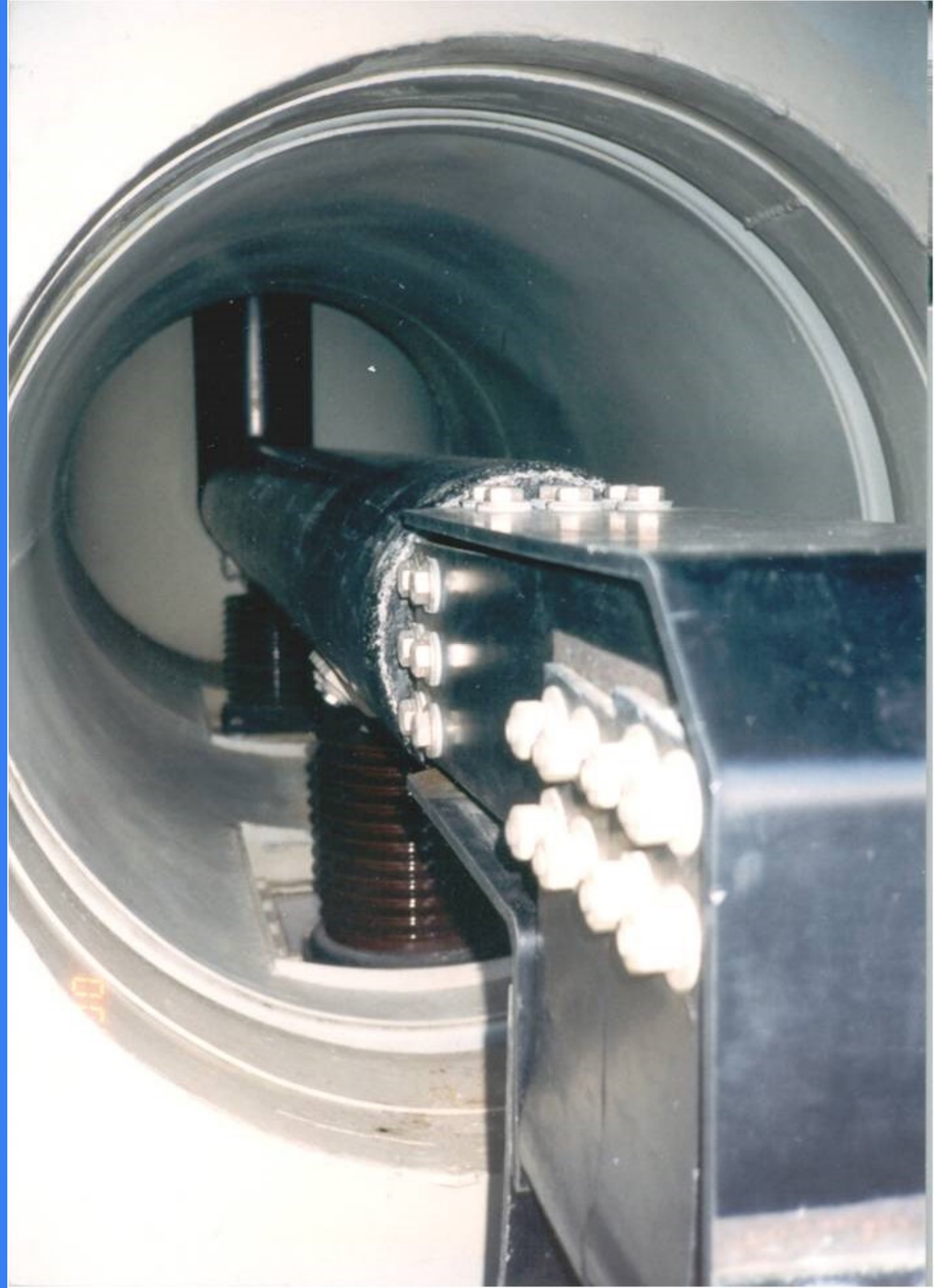

Main Generator
Connections to Switchyard (Offsite Power Grid)
Isophase Buses
Main Transformer

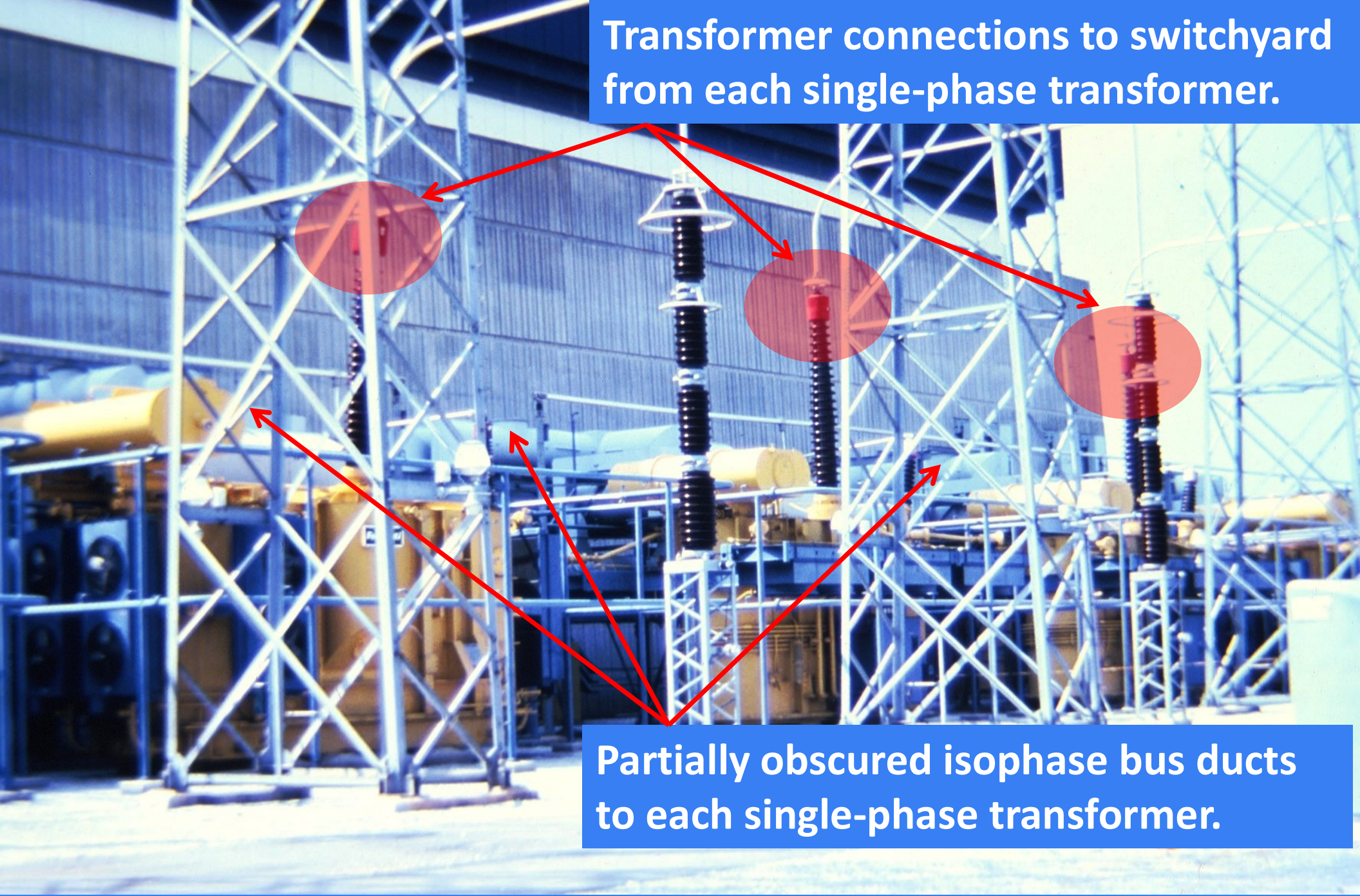


Looking up at the three isophase bus ducts passing through the turbine building from the main generator going to the main transformers.

View of an isophase bus inside its duct. The electrical current flowing through the isophase bus gives off considerable heat. The enclosing duct allows cooling air to flow past the isophase bus to remove the heat.

CAUTION: *Do not crawl inside an isophase bus duct when the bus is energized to avoid a very bad kind of "flash photography."*

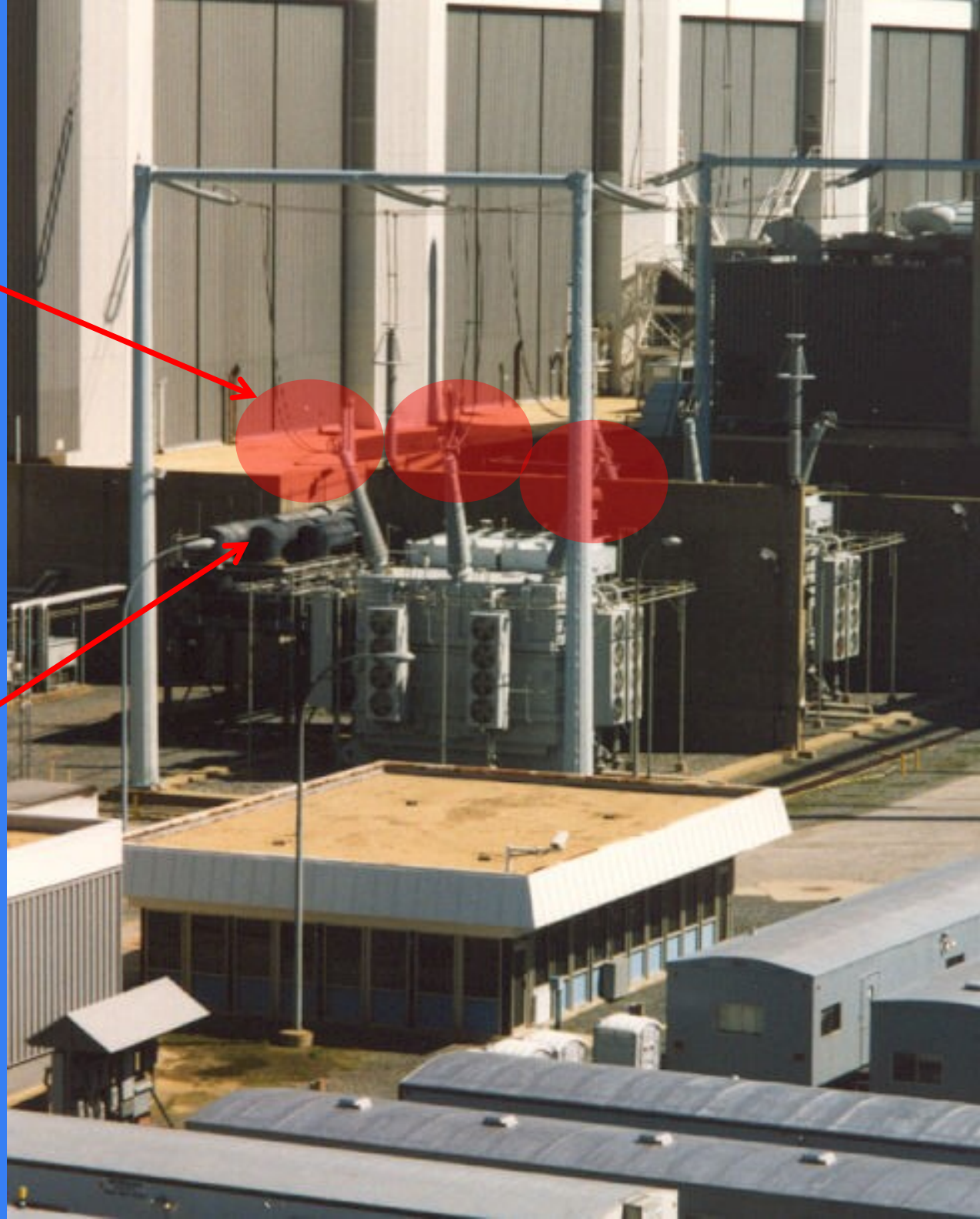




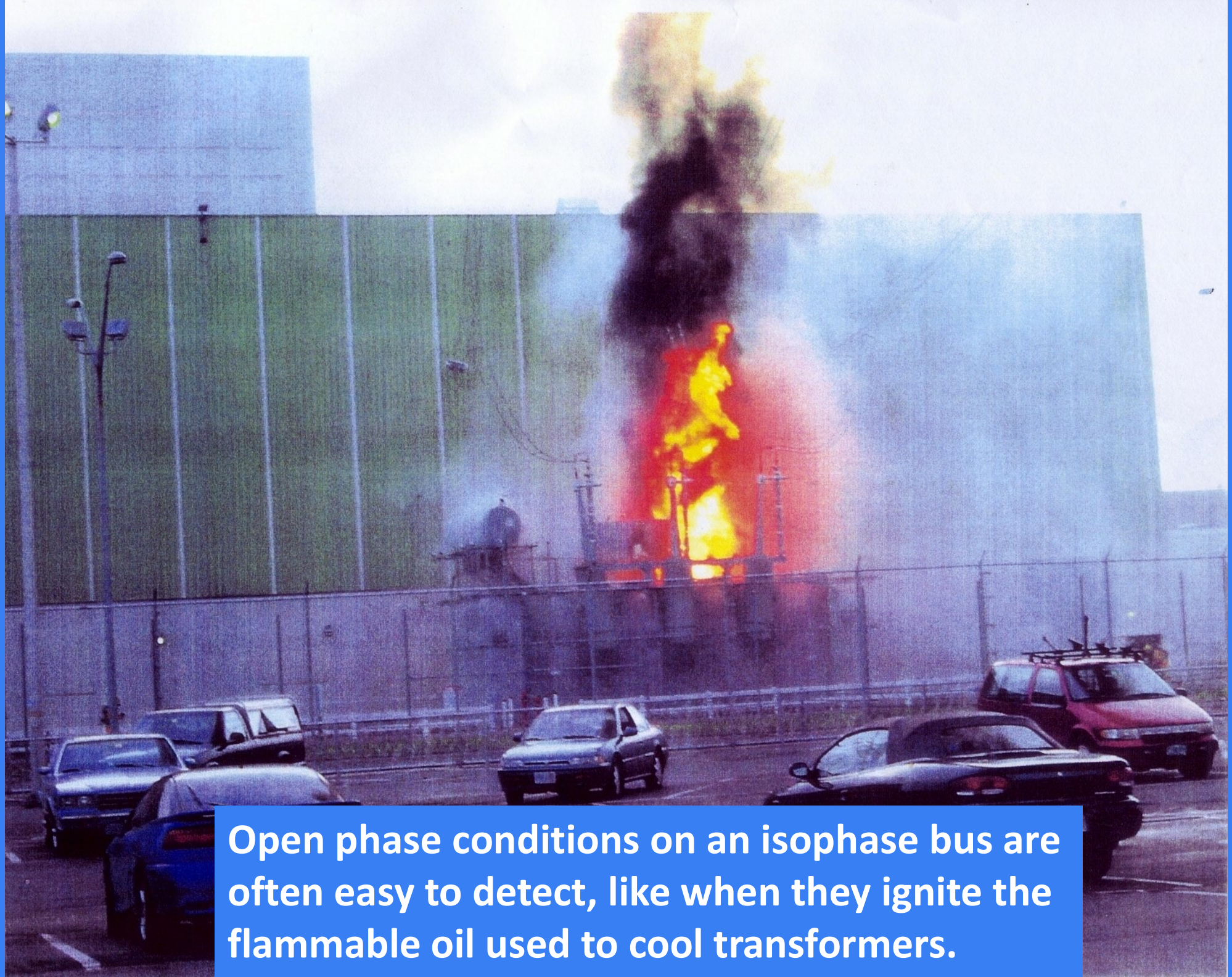
The transformers increase the voltage level of the electricity, typically from 24,000 volts to as high as 500,000 volts for transmission by the offsite grid.

Transformer connections to switchyard.

Partially obscured isophase bus ducts



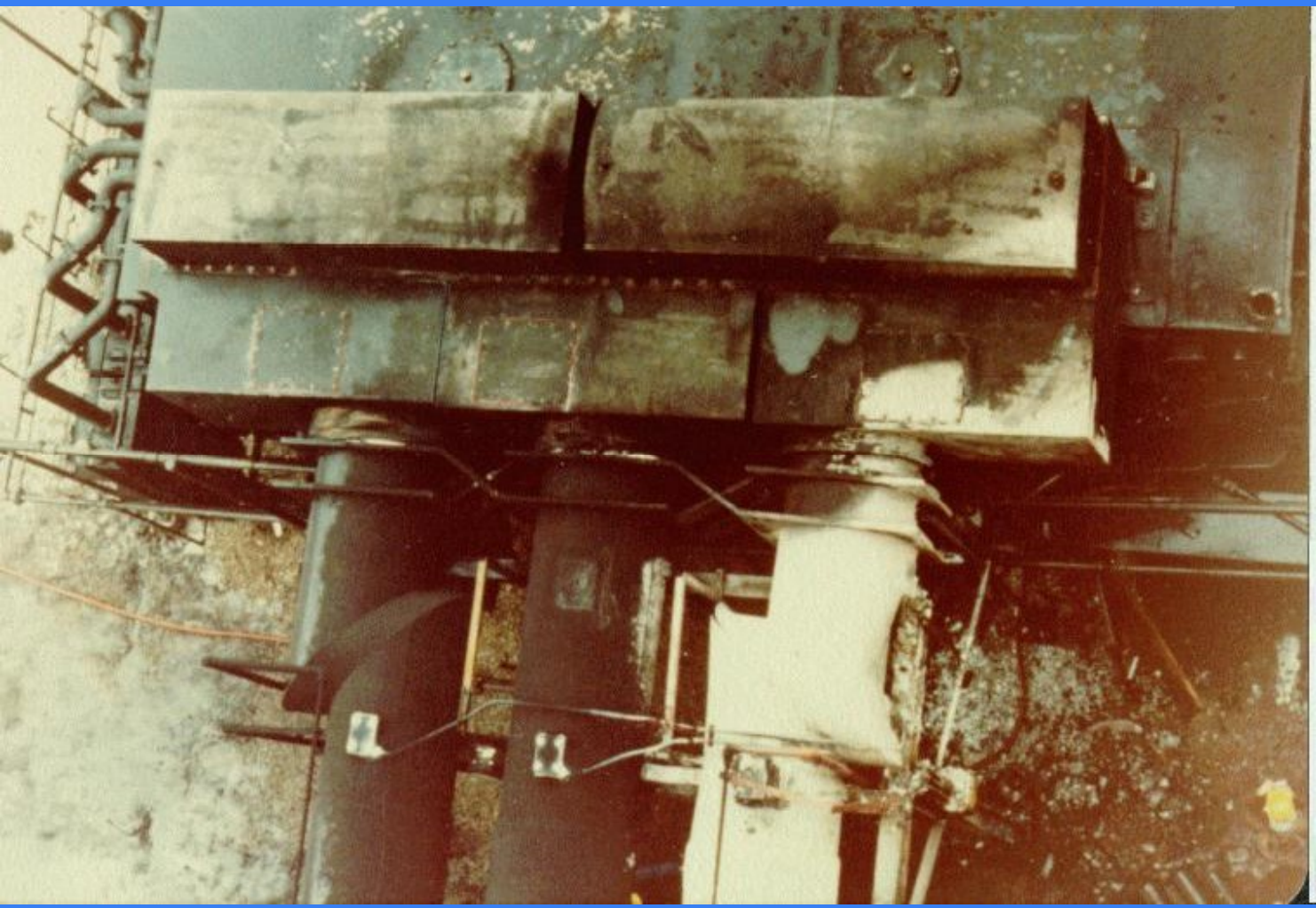
Many of the open phase conditions occurred when one connection to a transformer breaks.



Open phase conditions on an isophase bus are often easy to detect, like when they ignite the flammable oil used to cool transformers.

Overhead view of damaged bus duct following the Feb. 23, 1979 Unit 3 Main Generator Step-Up transformer. Note the discoloration of the A-Phase duct resulting from the intense heat of the fire.

And when electricity from an open phase on an isophase bus arcs through the duct, as during this event at Dresden Unit 3.



Closer view of the damaged bus duct at the transformer hood / miniflux plate area. Note the hole in the A-Phase enclosure and the aluminum slag on the ground that was the result of extensive arcing from phase to ground.

Close view of the miniflux plate area of the A-Phase bus at the transformer. Note the extensive damage to the 2" thick miniflux plate. Also note the temporary clamping ring installed after the first failure to serve as a means to attach the temporary bus duct boot.