UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

JUL 23 1986

MEMORANDUM FOR: Stewart D. Ebneter, Director
Division of Reactor Safety
Region I

FROM: Robert L. Baer, Chief
Engineering and Generic Communications Branch
Division of Emergency Preparedness
and Engineering Response
Office of Inspection and Enforcement

SUBJECT: LOW OIL LEVEL IN ESSENTIAL UNIT SUBSTATION TRANSFORMERS AT OYSTER CREEK NUCLEAR GENERATING STATION

Reference: Memorandum, Baer to Ebneter, 3-19-86, same subject

This memorandum is to inform you of our review of the subject event. As we noted in our previous memorandum, we did not identify any similar transformer problems in our search of the LER, Part 21 or 50.55(e) reports. The previous memorandum also noted that we would visit the GE Medium Transformer Manufacturing Facility in Rome, Georgia to determine the scope of the problem and appropriate IE action.

IE staff members from this branch and the Vendor Program Branch visited the manufacturing plant in June, 1986. They reviewed the manufacturing process, the quality control and the specific concerns involving this event. They also discussed previous transformer failures, corrective actions, and design detail with the GE staff. Based on this plant visit, the previous information provided in the region inspection and discussions with the licensee, we believe that this event was an isolated incident without major safety significance and therefore, an information notice is not required. However, some of the information obtained during this review could be of use in developing maintenance programs. By separate memorandum we are providing copies of the Region I inspection report, the licensee's LER, and a summary of the information we obtained during our review to the Maintenance and Training Branch, Division of Human Factors Technology, NRR for their use in the development of the generic maintenance programs. You are on distribution for that memorandum.

Contact: James C. Stewart, IE
492-9061

We highlighted the following three items to NRR:

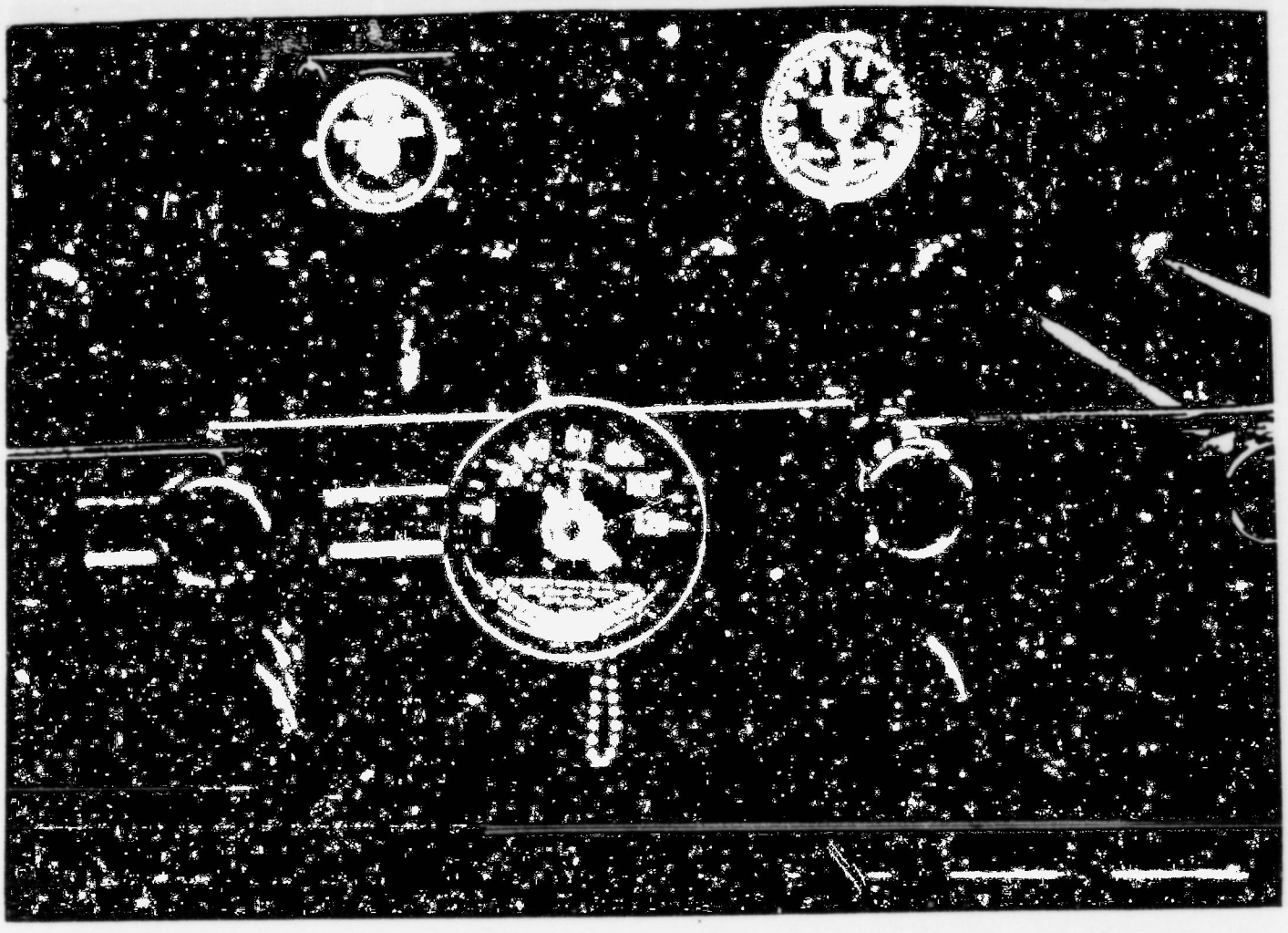
1) There was no record that the oil level had ever been checked except by the sight gage since it was delivered 17 years ago. Before the event, there was no scheduled plan to inspect the oil level for the duration of plant life.
2) The oil level gage was apparently trusted as accurate by the licensee without the necessary comparison with the oil temperature gage. Although GE stated that this has not been a major problem, they published an article (Ref. enclosure) in a trade magazine in 1971 on how to properly utilize transformer instrumentation.
3) The licensee did not keep complete records of the amount of oil removed for testing.

We do not plan any further action at this time.

Robert L. Baer, Chief
Engineering and Generic
Communications Branch
Division of Emergency Preparedness
and Engineering Response
Office of Inspection and Enforcement

Enclosure: General Electric Reprint
GER-2705 from April 1971
issue of Electrical South

GER-2705



Alert to transformer gage indications

by R. J. Ristow

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GENERAL ELECTRIC

Alert to transformer gage

By R. J. Ristow, Design Engineer, General Electric Medium Transformer Products Department, Rome, Georgia.

"Don't let those gages fool you" is a key idea in reviewing with electrical maintenance and operating personnel the operation of gages on all indoor and outdoor liquid-filled transformers.

All too often, a concerned electrical superintendent will call the transformer manufacturer when an oil temperature gage reads 65 degrees C and the transformer is carrying only half load. He is afraid to load his transformer any more, because the nameplate states that it is suitable for a certain kVA at 65 degree C rise.

The key word, of course, is "rise." It means that the transformer windings will enjoy a normal life if their temperature does not exceed 65 degrees C over the ambient or surrounding temperature. If the surrounding air is 86 degrees F or 30 degrees C, then the actual temperature of the windings could be 65 degrees C + 30 degrees C, or 95 degrees C.

This may not mean much, of course, to operating personnel. They see only an oil temperature gage; no one has told them what it should read. They know it has some relationship to the winding temperature, but what that relationship is, often is not known. As a general rule, for a 65 degree C rise transformer carrying rated kVA, this oil temperature gage will read approximately 90 degrees C. At this temperature, the oil in the middle of the winding will be about 80 degrees C and the windings about 95 degrees C. This corresponds to a 65 degree C rise over an ambient of 30 degrees C. For a 55 degree C rise transformer, the oil temperature gage should read about 80 degrees C under normal load at an ambient of 30 degrees C.

Transformers also are supplied with two other gages, the liquid level gage and the pressure vacuum gage. If properly read and evaluated, these gages can show when something is about to go wrong, thereby preventing an electrical outage.

It is important to note that all three gages must be read before one can accurately predict the condition of the transformer. Both the liquid level and the pressure inside the transformer are determined by the temperature of the insulating liquid. High temperatures are accompanied by high liquid levels (because of liquid expansion) and, consequently, high pressure. If, for instance, the oil temperature gage reads 90 degrees C and the liquid level gage reads high but the pressure gage reads zero, then a transformer leak may exist. If no leaking liquid is present, the leak is probably in the air space above the liquid.

One common cause of transformer failure is operation without sufficient liquid. This can happen easily if no one watches the transformer gages and if the unit does not have a low liquid level alarm. Transformer cooling depends on liquid expansion forcing the hot liquid into the top of the tube headers, where the liquid gives off its heat to the outside air as it flows down through the tubes. The tubes should be hot at the top and get cooler as they progress downward.

If for some reason, such as a leak, there is insufficient liquid in the tank to reach the top opening of the tubes when it starts getting hot, the unit will burn itself up. The oil temperature gage may not even indicate any trouble, because the sensing bulb will be out of oil, reading only the temperature of the air space. Both the pressure gage and the liquid level gage also will read low. So for an inexperienced person, everything will appear normal with all gages reading low. What he neglects to take into consideration is the load on the transformer.

If all gages are reading low, then the load should be very small or the day very cold. If the surrounding air is warm and the load is moderate to heavy, then the oil temperature gage should read a temperature increase, the liquid level gage indicate a high level, and the pressure gage

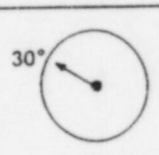
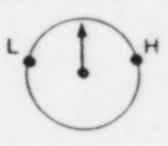
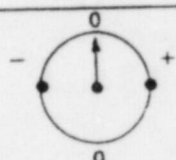
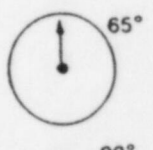
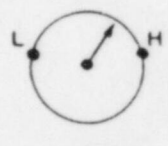
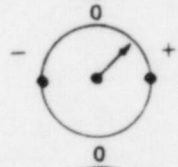
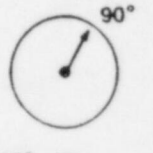
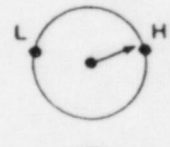
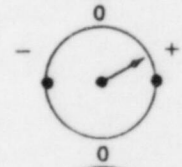
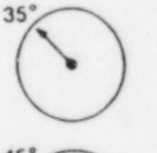
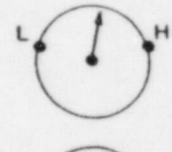
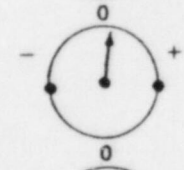
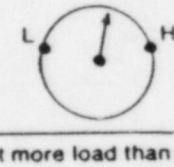
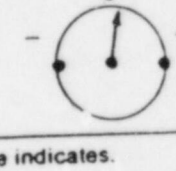
indications

Potential trouble may be averted by the proper analysis of gage readings

show some positive pressure. The table illustrates normal gage readings with various conditions of ambient temperature and load.

Sometimes it becomes necessary to supply short time overloads to a transformer. When this happens, the oil temperature gage cannot serve as a loading guide. It takes two to four hours before the full effect of a load registers on an oil temperature gage. This is because first, the winding and core have to heat up, and then the oil heats up. The temperature of the oil can rise even after load is reduced because of this time lag. If the ambient temperature falls below 30 degrees C (86 degrees F), then overloads are permissible (approximately one percent extra kVA per one degree C lower temperature). For ambients above 30 degrees C, the kVA output must be decreased 1.5 percent for each one degree C higher temperature.

Gages can fool, even if one watches them, but not with some applied reasoning and analysis. A person can spot potential problems, avoid trouble, and assure himself of power system reliability by being familiar with transformer gages.

Ambient	Load	Oil temperature gage	Liquid level gage	Pressure vacuum gage
30°C	None			
30°C	Moderate			
30°C	Rated kVA			
0°C	Moderate			
20°C*	Rated kVA			

*At this temperature, the transformer could carry 50 percent more load than the nameplate indicates.

The table shows normal gage readings with various conditions of ambient temperature and load.

Reprinted from April 1971 issue of ELECTRICAL SOUTH