FACILITIES INSTRUCTIONS,
STANDARDS AND TECHNIQUES
VOLUME 3-17

POWER CIRCUIT BREAKER PROBLEMS

Internet Version of This Manual Created
December 1999

HYDROELECTRIC RESEARCH AND
TECHNICAL SERVICES GROUP

The Appearance of the Internet Version of This
Manual May differ From the Original, but the Contents Do Not

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
DENVER, COLORADO

CIRCUIT BREAKER PROBLEMS

Volume 3-17

CONTENTS

Circuit Breaker Problems

REPORT ON GENERAL ELECTRIC COMPANY TYPE ATB AIRBLAST CIRCUIT BREAKERS

The following is an excerpt from a report prepared in 1966 by a Reclamation employee on a General Electric Symposium covering Type ATB Airblast Circuit Breakers:

One of the problems which has not been completely solved is air leaks from the mechanism control valves. The company has recently redesigned the valves with new valve seat material and will distribute these new valves in kit form in the near future.

The company relates that they have done much research in the testing of material for "O" rings and gaskets and they feel the material they are presently using will provide a service life in excess of 15 years. Inservice life will be longer than shelf life since the rings are in a perfectly dry environment and are not exposed to the deteriorating effects of sunlight. Other clients agreed that "O" ring leaks had not been a particular problem thus far.

The company told of problems caused by coating silicone "O" rings with silicone grease and by wearing of the Teflon coating from control valve "O" rings. It was also pointed out that one should not arbitrarily substitute ordinary "O" rings for sliding seals since sliding friction of certain materials could seriously affect breaker timing. Most air and gas leaks are said to be found in the tube fittings, valves, and gauges of their respective piping systems rather than in the "O" rings.

The Philadelphia Electric Company has had trouble with resistor switch porcelain supports breaking or coming loose at the base. The company is looking into this further.

Some companies have had difficulty with moisture in the high-pressure air systems. This moisture can cause flashovers in the interrupter compartment and in the air lines running from the base of the columns to the interrupter heads. General Electric says that the moisture usually gets into the 500-pound air system from the compressor system due to failure to follow recommended operating procedures precisely. General Electric depends on expansion of air from the 2,000-pound storage system to the 500- pound operational system to provide dry operating air. Air that is not allowed to "rest" in the 2,000-pound system for a short time can carry water over into the 500-pound system. A subsequent drop in ambient temperature can cause this moisture to precipitate into the confines of the 500-pound system, thus resulting in reduced insulating values. Quarterly tests are advised to ensure no moisture accumulates in the interrupter heads. In order to provide increased protection from the above condition, General Electric is presently equipping all their

(FIST 3-17 1/92)

ATB's with a desiccant air dryer mounted between the compressor fourth stage ant the 2,000-pound air receiver. They state that while the dryer is a worthwhile addition to the air system, it is by no means essential to satisfactory operation.

When asked about instruction books not accurately representing the model of ATB furnished, the company pointed out the impracticability of instruction book revisions for each small modification made on the mechanism. In the matter of renewal parts, they say they will be able to ship the correct parts if the breaker serial or type number is included on the requisition.

When asked also about the burning of control coils due to failure of the control circuit to clear on closure of the breaker, the company replied that complaints of this nature were caused by failure to place the cover on the Y relay properly or by replacing the Y relay cover with the cover from one of the other HGA relays in the cabinet. The Y relay cover has special cutouts on it for adequate clearance.

There was considerable discussion concerning compressor problems. General Electric feels that much of their early problems were due to failure to get Worthington to recognize and correct compressor troubles as they became evident in field service. Much of this lack of liaison and coordination has been corrected and they feel this present machine, Model 754, is satisfactory in all respects and should pro-vide 1,500 plus hours of operation between overhauls.

The compressor package has been im-, proved in several ways over the Model 742:

1. The first stage cylinder has been provided with pressure oil feed.

2. Weak unloader check valves have been replaced with larger valves. These are available in a replacement kit.

3. A dryer has been added to the compressor package and connected between the fourth stage and the 2,000-pound receiver. This is a silicagel dryer that is self-regenerating.

4. The company now has recommended use of a new oil for the compressors. The oil, Sun Oil Company's "Solnus 500," was a nondetergent oil made expressly for air compressor use. The new oil, Esso D-3, 30 weight, is high-detergency motor oil. General Electric claims much better performance from the new oil and is providing it in all compressors presently being shipped. They are reluctant to recommend that compressors be switched from the Solnus 500 to the Esso D-32 for fear of what the high-detergency oil might break loose into the crankcase. They suggest a change be made to the new oil whenever a compressor is overhauled.

MALFUNCTION OF TYPE AA-14 PNEUMATIC MECHANISM ON A WESTINGHOUSE OIL POWER CIRCUIT BREAKER

A low pressure cutout switch in the operating mechanism of the subject oil circuit breakers has been known to fail to operate properly resulting in failure of the breaker it was associated with. This switch is used with almost all Westinghouse-type AA mechanisms.

A dielectric failure to tank was reported on a Westinghouse 345-kV, Type GW oil circuit breaker late in December 1968. Icing of lines followed by "dancing" conductors lead to multiple phase-to-phase faults. Seven breaker operations were recorded in the course of a few minutes, terminating with a breakdown to tank.

Following these events, the breaker was completely inspected with these findings. The mechanism closing magnets had been roasted and the X-relay on the breaker panel was sealed in. Resistor-capacitor voltage dividers on all interrupters had suffered damage internally of a thermal overload nature to the carbon-block, grid-shunting, high-ohmic-value-resistor components. Also, there were arc scars on the tank wall, but fortunately the power-follow currents were Low and of short duration so that structural damage was minor.

Analysis revealed that on the final close, the breaker had failed to latch and drifted open slowly as the air pressure on the closing mechanism piston diminished.

Since the breaker attempted to close with insufficient air pressure, it was deduced that the Low-pressure cutout switch was not functioning. Dismantling the air line to this switch disclosed the cause. A small auxiliary air reservoir supplies the Low-pressure alarm and cutout switches and in turn is fed from the air manifold through a restrictive orifice 0.016-inch diameter. This arrangement desensitizes these switches to momentary pressure transients. The orifice was discovered completely blocked with corrosion. Correction by redrilling restored the normal aperture and proper switch response.

While little is said about this orifice in power circuit breaker instruction books, this incident illustrates the importance of it being free of contamination. As a precautionary measure, the operation of Low-pressure cutout switches should be checked whenever a breaker is maintained. When pressure is dropped in the manifold system, check that the cutoff switch responds without abnormal delay. A clogged orifice can result in a damaged breaker. The orifice is installed in the auxiliary reservoir end of the 1/8-inch tube connecting it to the air supply manifold.

(FIST 3-17 1/92)

AIR LEAKS IN WESTINGHOUSE TYPE AA OCB PNEUMATIC OPERATING MECHANISMS

Failures of "Nylaflow" nylon tubing in the Type AA pneumatic operating mechanisms on oil circuit breakers has been recognized as a chronic problem by the Westinghouse Electric Corporation. Westinghouse believes it has found a solution to the problem, and offers the following information on a product improvement kit:

> "Nylon tubing has been used for a number of years for connection of air reservoirs with pressure switches and gauges. Field experience has shown that after a period of exposure of a few years in the breaker operating environment the nylon tubing is subject to breakage. When this occurs, the breaker of course has no closing capability. As long as the nylon tube is in service, there is a remote possibility that the tube could break while personnel are working within the mechanism cabinet. The resultant noise could cause a reflex action that could result in injury due to the space confinement of the cabinet.
>
> We therefore offer as a product improvement a kit of materials to be used in replacing the nylon tubing. The nylon is replaced with copper tubing and flex fittings. The flex fittings are being used in current production breakers and have demonstrated ability to seal over a wide temperature range and to withstand vibration. In this application, the vibratory loading of compressor operation is damped out so that the copper tubing does not work harden.
>
> The materials needed to replace nylon tubing and assembly instructions are included in the kit. Style identifications of kits for standard pneumatic mechanisms are shown in table 1.
>
> For breakers shipped after January 1, 1971, the kits will be provided on a no-charge warranty basis for customers requesting them. The customer is responsible for installation.
>
> For breakers shipped prior to January 1, 1971, the kits are available as a product improvement for customer purchase at $20 each. The kits will be available for shipment starting June 19, 1972. Production breakers will incorporate this product improvement at the same time.

Kits to be provided on a warranty basis should be ordered by telegraphic order entry system, general order plus five-digit number, to the attention of George Stevanus. Include in the order entry a reference to the charge 9010-4-3333-2, breaker type, shop order number, and serial number. Because many different product codes are involved, we will assign the appropriate code here at Trafford."

(FIST 3-17 1/92)

Table 1

MECHANISM	BREAKER TYPE AND RATING	KIT STYLE
AA-7	G and GS, 1200A, 14.4-69kV	S# 777B597G01
AA- 10-60	GMSC-138kV, GM5B-161 kY, G Breakers rated 2,000 A and above	S# 777B597G01
AA-10-R-80	2300SF15000/20000	S# 777B597G02
AA- 10-80	GM-115-161kV, 10000MVA and above	S# 777B597G03
AA-14	GW,230-345kV	S# 777B597G04
AA-10-60 MATS	1150GM5000	S# 777B597G05

(FIST 3-17 1/92)