FINAL REPORT OF

GE TYPE AK-2-25
CIRCUIT BREAKER
S/N 228A4389-200-BMG

FAILURE AT

FLORIDA POWER & LIGHT COMPANY'S
ST. LUCIE NUCLEAR PLANT UNIT 1

PREPARED BY

GE NUCLEAR ENERGY
NORCROSS, GEORGIA

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REVISION 1

EVENTS

Florida Power and Light's St. Lucie Nuclear Plant Unit 1 experienced a failure to close of a GE Type AK-25 circuit breaker used as a Reactor Trip Circuit Breaker. The ensuing investigation revealed that the breaker operating springs had disengaged from the breaker mechanism and fallen out of the circuit breaker. Subsequent inspection of the unit's other reactor trip breakers revealed that three (3) of the nine (9) circuit breakers contained operating springs that were not installed in the proper configuration.

The "failed" circuit breaker (serial number 228A4389-20C-8MG) was shipped to the GE Apparatus Service Center (GE-ASC) in Chamblee, Georgia, for inspection and repair. Upon inspection, one of the two springs returned with the breaker was found to be the incorrect spring. The two (2) operating springs in the Type AK-2-25 circuit breakers should be mirror images of one another. In this case, both springs were the same. The circuit breaker is still in the Chamblee, Georgia, GE-ASC awaiting overhaul.

The unit's other three (3) circuit breakers (serial numbers 228A4389-200-2, 228A4389-200-9MG, and 228A4389-200-5RR) that contained operating springs in an improper configuration had the proper springs, but they were installed on the opposite sides of the breaker mechanism. In other words, the spring that should have been installed on the right side of the circuit breaker was installed on the left side of the breaker and vice versa. The springs on these breakers were still engaged within the circuit breaker mechanism and the breakers were functioning properly.

On November 8,1990, the springs on these three (3) breakers were removed and properly reinstalled on-site

OPERATIONAL IMPACT

GE has conducted tests on the Type AK-25 circuit breakers to determine how the circuit breaker functions with various spring orientations, how the breaker functions with one or both springs missing, and what potentially causes the springs to disengage from the mechanism.

The results of these tests revealed the following:

1. A circuit breaker that has successfully closed, and still has both springs in place, will trip regardless of the orientation of the springs.

2. A circuit breaker with only one (1) spring in place can "operate" provided that the disengaged spring does not jam the mechanism.

   With only one spring in place, the circuit breaker mechanism will not latch closed and the main contact wipe on at least one phase will have significantly less wipe than the other two (2) phases. Depending on how "heavy" the contact wipes were adjusted, the contacts could possibly not make contact at all.

3. If a circuit breaker loses both operating springs, the breaker will not close.

4. The actual spring configuration appears to be one of the factors affecting whether the spring(s) disengages or not. While a spring orientation (as shown in Figure 2 attached) appears to be less likely to disengage, the disengagement is not repeatable; therefore, no firm conclusion can be reached. (This configuration did not fail during the evaluation testing.)

5. Since the spring disengagement cannot be reproduced with any certainty, the exact disengagement cause cannot be determined.

In the case of the "failed" reactor trip breaker at St. Lucie, prior to the reported failure, this circuit breaker had functioned properly through four (4) years of plant operation and testing.

OTHER CONCERNS

During the course of the investigation into the failure of the St. Lucie Unit 1 breaker, it was discovered that the operating springs were not installed on three (3) Unit 1 reactor trip breakers in accordance with the current revision of the GE drawing. While investigating this apparent discrepancy, the following information was determined.

GE Type AK-25 Circuit Breakers have been manufactured since the 1940's. During this time, many drawing revisions have been made. Some of these drawing revisions were made to correct problems, some of the revisions were made to include more detail, some were made to reflect changes in material and/or processes, and some revisions were made to reflect changes in manufacturing practices.

In the case of the circuit breaker operating springs, a drawing revision (Revision 6) was made in late 1985 to reflect in the drawing the preferred manufacturing installation orientation of springs during the manufacturing process. In essence, this change rolled each spring 180° longitudinally and, as a result of this roll, swapped the left hand spring to the right side of the breaker and the right hand spring to the left side of the breaker in order to retain the correct orientation and operation of the springs. This new spring orientation is shown in Figure 1 while the older orientation is shown in Figure 2.

In either orientation, the intent is for the curve between the spring hook and the first spring coil to curve away from the centerline of the circuit breaker.

CONCLUSIONS

1. An incorrect operating spring was installed in a St. Lucie "failed" circuit breaker. This incorrect spring is believed to have been installed inadvertently by GE at the GE-ASC in 1986.

2. Three (3) St. Lucie Unit 1 Reactor Trip Breakers contained operating springs installed improperly. These improperly installed springs were also apparently installed by GE in March, 1983 (2 breakers) and in April, 1989 (1 breaker).

3. This failure of the St. Lucie Reactor Trip Breaker to close is not a safety concern because testing has revealed that the circuit breaker will not close unless the operating springs are in position. When the breaker is being closed or is closed, the spring tension keeps the springs in their position in the mechanism. Therefore, if the breaker closes, it will open when required to fulfill its safety function in the plant.

4. The actual orientation of the springs is satisfactory if they are installed in accordance with either Figure 1 or Figure 2.

5. This failure occurrence points out a potential for a common cause error involving incorrect selection of the spring during breaker assembly. However, the consequent breaker failure appears to be random. The St. Lucie "failed" breaker in fact operated properly and passed all functional tests for a period of four (4) years prior to failure.

CORRECTION ACTIONS

1. The three (3) St. Lucie Unit 1 Reactor Trip Breakers with improperly oriented springs were "corrected" on November 8, 1990.

2. A specific checkpoint has been added to the AK-25 overhaul and maintenance processes to ensure that the operating springs are properly oriented in the breaker mechanisms.

FIGURE 1 (Revised)

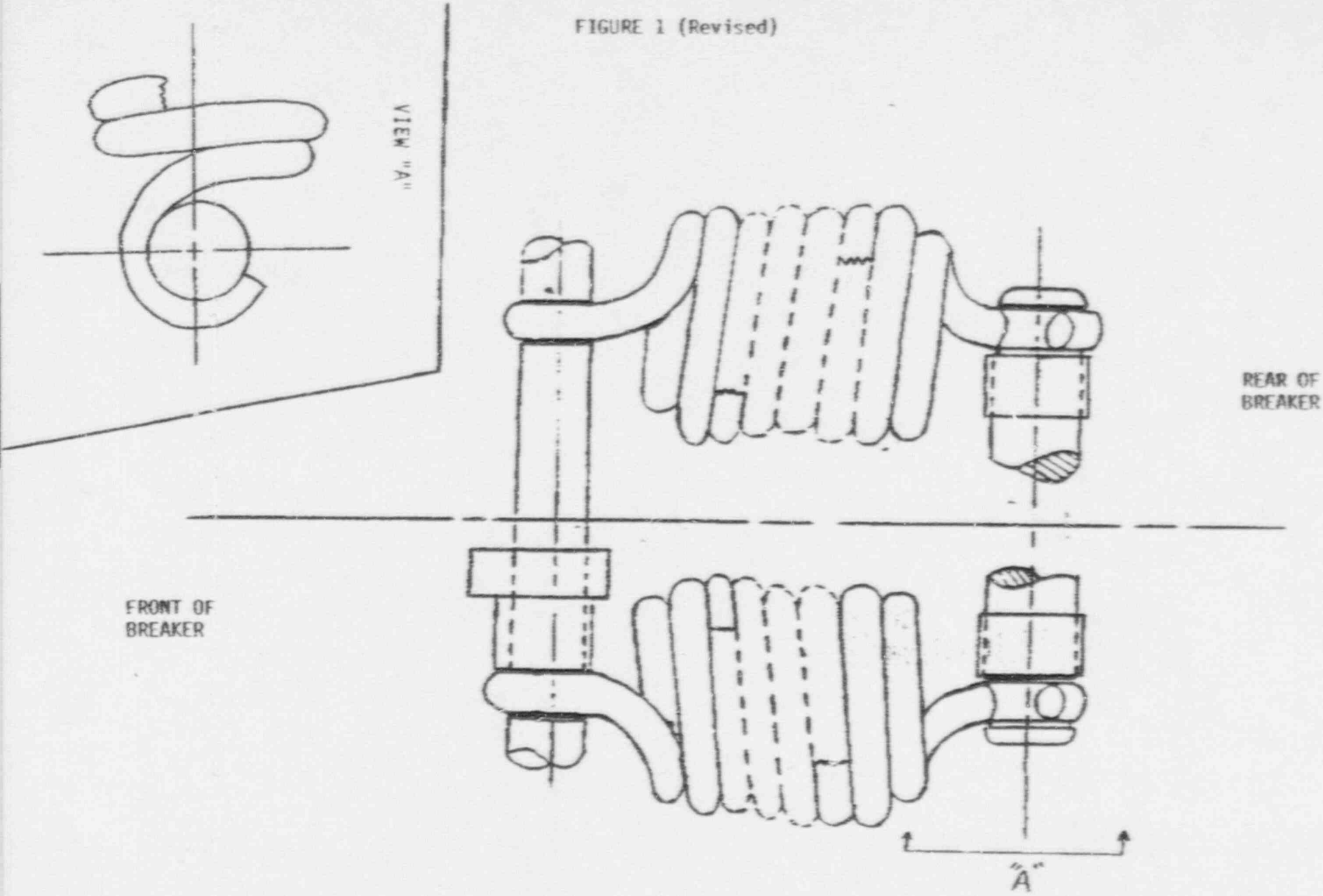

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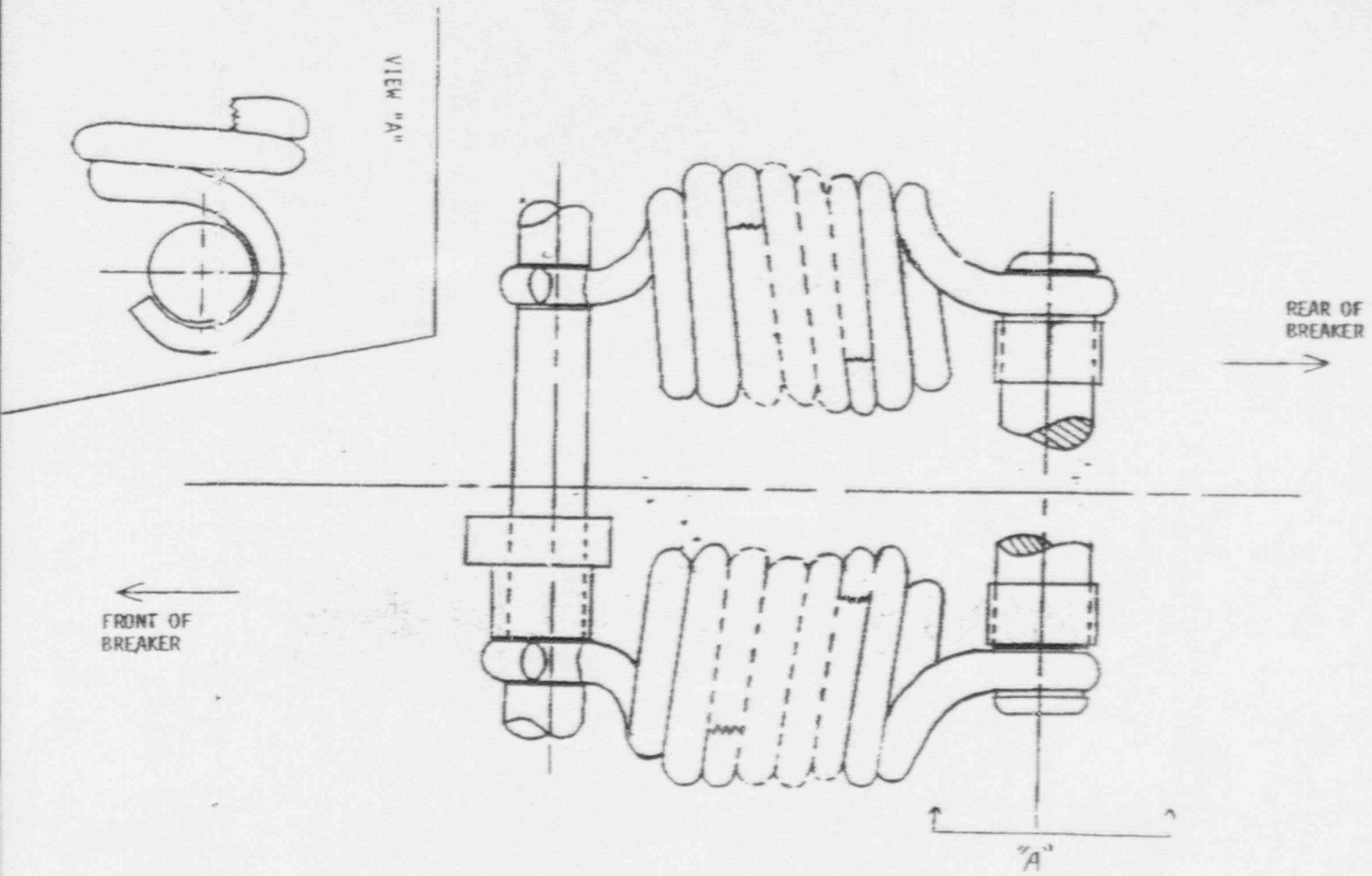
FIGURE 2 (Revised)



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