Alabama Power Company
40 Inverness Center Parkway
Post Office Box 1295
Birmingham, Alabama 35201
Telephone 205 868 5096

J. D. Woodard
Vice President-Nuclear
Farley Project

June 18, 1991

Alabama Power
the southern electric system

Docket Nos. 50-348
50-364

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D. C. 20555

Joseph M. Farley Nuclear Plant
Response to NRC Bulletin 88-10

Gentlemen:

In a phone conversation between your Mr. Stephen T. Hoffman and Mr. B. L. Moore of Alabama Power Company, questions concerning our response of November 6, 1989 to NRC Bulletin 88-10 were raised. These questions were centered on the hold-in test (test section 2.3 of Attachment 1 to NRC Bulletin 88-10) for a Heinemann Model AM2-A3-A molded case circuit breaker. This circuit breaker passed the hold-in test at 95.3% of rated current instead of the required 100%.

Subsequent to this phone call a letter dated April 26, 1991 was received by Alabama Power Company requesting the following information for the Heinemann Model AM2-A3-A molded case circuit breaker in question:

A. Documentation, such as vendor descriptions, indicating whether the breaker is of magnetic or magnetic and thermal design.

B. Trip characteristic curves for the breaker.

C. Excerpts from the Wyle test program which explain the rated current hold-in test and the basis for the deviation to test at 95.3% of rated current instead of at 100%.

Attachments 1, 2, and 3 to this letter contain the information requested above. In addition, sheet 2 to attachment 3 includes the basis for the acceptability of the hold-in test value that Wyle used.

If you have any questions, please advise.

Respectfully submitted,

J. D. Woodard

JDW/CCM:cht-91.8.10

Attachments

cc: Mr. S. D. Ebneter
Mr. S. T. Hoffman
Mr. G. F. Maxwell



IE22
1/1

ATTACHMENT 1
SH 1 OF 2

# Precise Overload Protection – with Heinemann Hydraulic-Magnetic Circuit Breakers

**Heat-induced nuisance tripping eliminated**

Heinemann hydraulic-magnetic circuit breakers offer three major advantages over thermal devices:

1. Elimination of nuisance tripping caused by high ambient temperatures in or near the installation. The breaker responds only to current variations, not to temperature change.
2. Assurance that 100% of the rated current will be carried. There is no such assurance with thermal devices, which may fail to carry rated current when subjected to above-normal ambient temperatures. A Heinemann breaker rated at 20 A, for example, will sustain 20 A, even at elevated temperatures. Derating and other forms of temperature compensation are unnecessary.
3. Immediate reset. Since there are no thermal elements, heat build-up is not a factor. Therefore, no "cooling off" period is required after fault interruption.

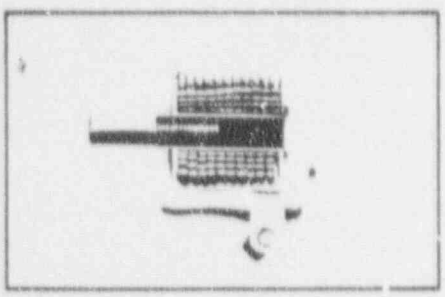
**Time delay eliminates breaker tripping due to transient current surges**

Elimination of transient current surges as a cause of nuisance tripping is accomplished through the creation of a controlled time delay. In any installation where a power supply or compressor motor is on the line, an inrush of current occurs when the equipment is first turned on. The bigger the equipment, the larger the surge. Although inrush surges are, in fact, transient overloads, they usually pose no threat of damage to the line or to the equipment. So, it is not necessary or even desirable to interrupt the power when they occur.

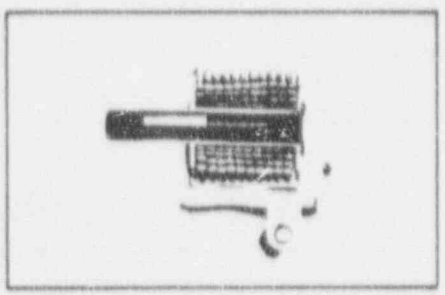
The hydraulically-controlled time-delay mechanism of a Heinemann breaker eliminates nuisance tripping without lessening overload protection. The delay is inversely proportional to the overload; response is quicker on large overloads, where greater potential danger exists, and slower on small overloads. Except in special high-inrush models, heavy overload and short-circuit currents of greater than 10 times the breaker's rating provide instantaneous response. (An instantaneous-trip breaker is available for use on, for example, modern medical and communication equipment, which can not tolerate even brief overloads.)

For added protection, the time-delay is self-adjusting to ambient temperature conditions. At high ambients, where the overload tolerance of most circuits is lowered, the viscosity of the special fluid in the breaker's dashpot is lessened, and the time-delay response is thereby shortened. At low temperatures, the response is correspondingly longer to allow for cold-equipment startups.

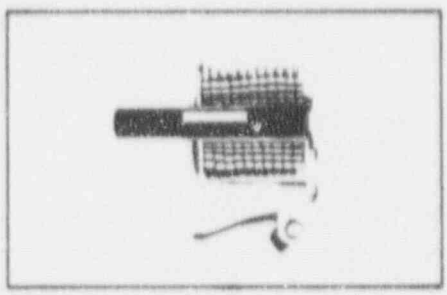
## The Hydraulic-Magnetic Principle (How the breaker works)



1. The Heinemann hydraulic-magnetic circuit breaker operates on load-current-produced magnetic-flux variations in a solenoid. The coil is wound around a hermetically-sealed, non-magnetic tube containing a spring-loaded, movable iron core in a special liquid fill. With the load current either at or below the breaker's nominal rating, the magnetic flux is of insufficient strength to move the core, so it remains at the end of the tube opposite the armature.



2. With excessive current, the magnetic-flux force increases, pulling the iron core toward the armature end of the tube. This core insertion reduces the reluctance of the magnetic circuit and further increases the strength of the magnetic field. The special liquid regulates the core's speed of travel, creating a controlled trip delay that is inversely proportional to the magnitude of the overload. If the overload subsides before the core reaches the pole piece, the core returns to its original position, and the breaker does not trip. (For non-delay applications, the breaker is modified to omit the intentional delay.)



3. When the magnetic flux reaches a predetermined value, the armature is attracted to the pole piece and the breaker trips. (The breaker may trip before the core reaches the pole piece if the critical flux value is achieved first.) On very heavy overloads or short circuits, the flux produced by the coil alone, regardless of core position, is sufficient to pull in the armature. This circuit interruption occurs with no intentional delay — a highly desirable response characteristic.

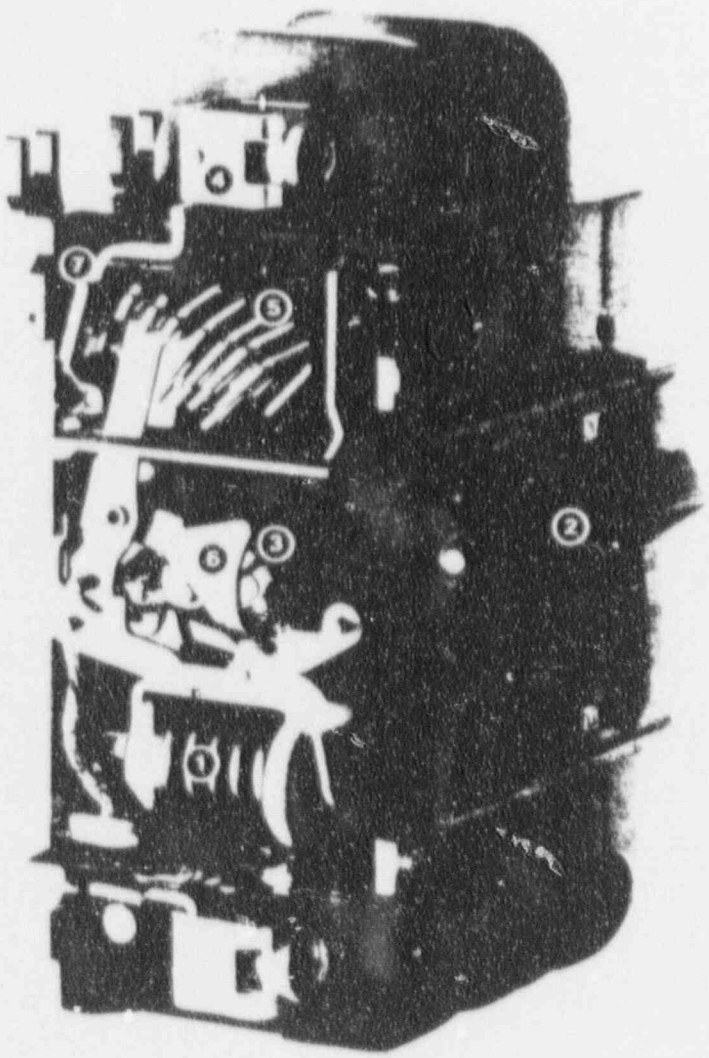
**Current rating and time delay is supplied to user specification**

The current rating of a Heinemann breaker is determined by the number of ampere-turns in the load-sensing coil. By altering the number of turns and wire size, Heinemann can provide a breaker of virtually any rating within the unit's overall range. It is even possible to specify current ratings in fractional values.

Time-delay characteristics can be precisely matched to the requirements of the application. A choice of many time-delay curves, including non-time-delay and high-inrush protection, is available on most single- and multi-pole breakers.

## A Look Inside

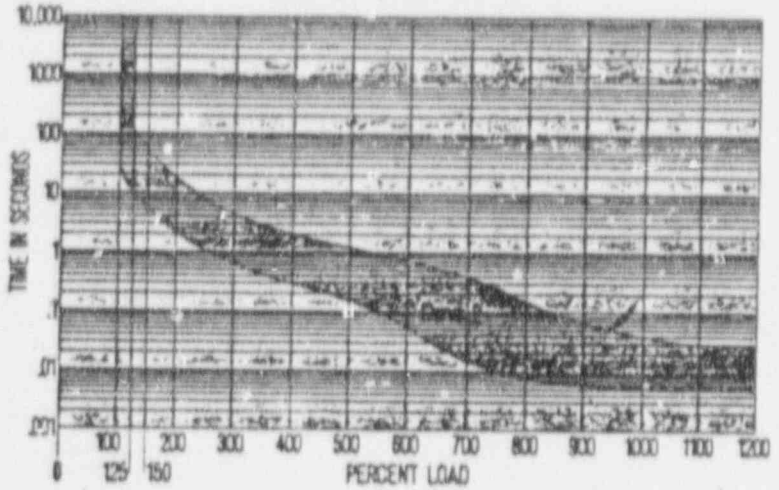
1. **Load-sensing coil**
   Magnetic unit measures current, not temperature, making it unnecessary to derate for high-ambient service. Coil will carry 100% rated load as specified in the appropriate response curve.
2. **Two-position switching**
   Two handle positions, ON and OFF (no ambiguous "reset" position). After fault clearance, simply snap the handle back to ON.
3. **Sturdy toggle and latch**
   Strong, durable, and effective. Latch is shock-resistant, yet provides very fast operation. Trip-free construction assures that the breaker will open against a fault. Even when handle is held in ON position, contacts will open when a fault occurs.
4. **Broad selection of terminal styles**
   Pressure connectors, threaded studs, hooks, bus, screw terminals, plug-ins, quick-connects or terminals for soldering are available. However, all terminal styles not necessarily available for all breakers. Consult separate product bulletins or factory.
5. **Efficient blowout grid**
   U-shaped grid plates extend, fragment, and extinguish contact arc. Charring and pitting of contacts is minimized.
6. **Balanced armature**
   A counterbalance added to the actuating armature serves to offset mechanical tripping caused by shock and vibration. Meets MIL-STD-202 requirements.
7. **Self-cleaning contacts**
   A sliding pivot causes a wiping action across the contacts each time a breaker is switched. This cleaning motion helps keep contact surface resistance low, extending contact life. Contacts are made of silver alloy for minimal wattage loss.



ATTACHMENT 2

# HEINEMANN SERIES AM/S CIRCUIT BREAKERS

Curve 2, 50/60Hz



Notice of Anomaly No. 2
J/N 40799
Page 2 of 3

DISPOSITION-COMMENTS-RECOMMENDATIONS (Continued).

2. Specimen AP-40799-5 was allowed to cool for approximately 40 minutes. It was re-energized with 100% rated current (Run 2). In addition to the test setup shown in Figure 5 of WLTP 6110-26, Revision F, a hand-held meter with 100 msec peak-hold capability was used to monitor for any current transients. The breaker tripped approximately 20 minutes into the test. No transients were noted; the peak reading on the hand-held meter was 15.44 A (rated current is 15 A).

   The specimen was allowed to cool for 2 1/2 hours. It was energized with 100% rated current (Run 3). WLTP 6110-26 requires current to be maintained at 100% ±5% of rated current. For Run 3 of the Rated Current Hold-In Test, the current was maintained at 97% - 100% of rated current. The breaker tripped 18 minutes and 15 seconds into the test.

   At the completion of Sections 2.5 through 2.7 of WLTP 6110-26, Run 4 of the Rated Current Hold-In Test was conducted. Current was maintained at 14.3 Amps (95.3% of rated current) throughout the test. The breaker held in for the required 1 hour. The Rated Current Hold-In Test was re-performed at a lower current because the manufacturer's time-current curve (see attached curve) shows that the breaker can trip in as little as 12 seconds at 100% current. Although Specimen AP-40799-5 does not meet the requirements of NRC Bulletin 88-10 for the Rated Current Hold-In Test, the four tests that have been performed demonstrate that the specimen performs in accordance with the manufacturer's specification.

## Basis For Acceptability Of Testing Hold-In Current At 95.3% In Leu Of 100%

The manufacturer's time current curves indicate that at 100% of rated current the Heinemann breaker can trip in less time than the required one hour specified in NRC Bulletin 88-10 (as little as 20 seconds). When Wyle realized this they reduced the current to a value that allowed Wyle to test the breaker to verify that the breaker would "hold-in" for one hour and thus meet the intent of the testing criteria outlined in NRC Bulletin 88-10.

This breaker was purchased as a spare for the Inadequate Core Cooling Monitoring System (ICCMS) and, as shown by the Wyle test report, would function as intended by the manufacturer, if used as a replacement for the circuit breaker now in service. The 95.3% value (14.3 amps) is much higher than the ICCMS equipment load (less than 10 amps). If installed, the breaker would never see a prolonged load of 100% of its rated current during the normal operation of the ICCMS equipment. Therefore a one hour "hold-in" at 100% current is not required for this breaker to perform its intended function. If an increase in loading is ever needed, a design change and engineering evaluation would be required to determine the acceptability of the Heinemann breaker for the increased load. Additionally this spare circuit breaker would not be used for other safety-related applications at FNP without a design change which would include an engineering evaluation of the acceptability of the breaker, based on its electrical characteristics including its time-current curve.

It is Alabama Power Company's position that the Wyle test proved that the Heinemann breaker in question was not a counterfeit breaker since it performed in accordance with the manufacturer's published time current data.