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TO: H. T. Wells - Contact Engineer - Project C-431-B

FROM: G. M. Roy *GmRoy*

RECOMMENDED SETTINGS FOR 105-C TRIPS
Reference: P-8717

Recommendation:

It is recommended that:

- (1) The LP trip (which trips the VSR) be set at 373 psig at the top of riser.
- (2) The time delay relay TD-2 be set at 5 seconds.
- (3) The LLP trip be set at 300 psig at the top of the riser.

Philosophy of Operation of Safety System

The overall safety system at "C" combines the high reliability of the Ball 3-X System with the more feasible - from the production standpoint - VSR System.

The VSR System has adequate control capacity for any emergency which leaves this system in good operating condition. An example of such an emergency would be a combined electrical and steam outage. Under such a condition it is both unnecessary and undesirable to drop the balls, for the use of the Ball 3-X System results in a loss of production of about one day.

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The more reliable Ball 3-X System serves two purposes:

- (1) It acts as a back-up for the VSR System for those emergency conditions where there is a small probability of sudden gain in reactivity due to loss of water.
- (2) In cases of extreme emergency - such as sudden loss of water - it operates without waiting to determine whether the VSR System has functioned properly. This is based on the premise that the act which caused the sudden loss of water may have rendered the vulnerable VSR System inoperative. In this case, it would be extremely hazardous to delay the dropping of the balls.

Basic Operation of Ball 3-X Trip Circuit

Figure I gives a simplified diagram of the Ball 3-X Actuating circuit. Opening of the LXX contact trips the VSR System and actuates relay TD-1 which in turn actuates TDI-R (time delay relay - ~ 4 sec) which de-energizes Y_1 ----- Y_7 and opens all Y contacts. The VSR bottom switch contacts (B_{16} - - - B_{60}) will keep the ball hopper solenoids (S_{16} --- S_{17}) closed. Thus, any rod not entering in about 4 seconds will cause a hopper to trip. This is the back-up circuit. Operation of the contacts LP works through relay TD-2, to start time delay relay TD2-R. Contact TD2-R closes at the end of this delay time "T". The opening of LLP before this delay time "T" has elapsed causes 72DI to open thereby tripping all hoppers. If LLP opens after the time "T" has elapsed, the balls do not drop.

Discussion on Setting of LP, LLP, and TDR-2

The LP switch is set at a pressure which is a compromise between feasibility of operation and achieving the highest degree of safety. A pressure drop of 30 pounds below normal is a practical choice.

Setting the time delay relay (TDR-2) at about 5 seconds is about the best choice for the following reasons. A rupture resulting in simultaneous loss of VSR system and pressure decay as shown by curve (1) of Figure 2, would be adequately protected against. For clarification of this statement, assume that such a rupture occurs and follow the events. The LLP contact would have opened before the TDR-2 contact can close, thus causing the balls to trip.

Now suppose that TDR-2 is set at an appreciably shorter time - say 1 second - the balls would not have tripped because of LLP (since contact TDR-2 has closed). Although the back up circuit would close after TDR-1 has timed out, the Ball 3-X circuit can be delayed as much as 3 seconds at a highly critical time. At present, it is contemplated that TDR-1 would be set at about 4 seconds. However, since the total bottoming time for some rods may be long, this time will have to be extended. This could be avoided by having the bottom limit switch at the point of start of deceleration. This time is short and consistent for all rods. The above argument using Curve (1) is then even more significant. Also setting this time a shade longer adds very little time for a very rapid decrease as in Curve (2). For a slower falling pressure curve, time is not so critical. Therefore, it is concluded that a setting of 5 seconds on TDR-2 is a good choice because:

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- (1) Protection is afforded against a fast decay.
- (2) Protection is afforded against a delayed fast-decay (as in Curve 2)
- (3) Inadvertent trips of the Ball 3-X should not occur.

Finally, the setting of LLP should allow about 0.5 second for sluggish operation of the relay and about 1.0 second for accuracy of the calculated decay. The LLP should be set at 300 psig.

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FIGURE 1

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FIGURE-2

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