Rev. Prof. D. W.

MASTER

~~For Internal Use Only~~

OAK RIDGE NATIONAL LABORATORY

Operated by

UNION CARBIDE NUCLEAR COMPANY

Division of Union Carbide Corporation

Post Office Box X

Oak Ridge, Tennessee

ORNL
CENTRAL FILES NUMBER

58-10-13

H. W. Savage

DATE: October 3, 1958

COPY NO. 4

SUBJECT: Thermocouple Liquid Level Indicator Used
on Cold Trap Stands

TO: Distribution

FROM: R. D. Peak

LEGAL NOTICE

This report was prepared as an account of Government sponsored work. Neither the United States, nor the Commission, nor any person acting on behalf of the Commission:

A. Makes any warranty or representation, expressed or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or

B. Assume any liabilities with respect to the use of, or for damages resulting from the use of any information, apparatus, method, or process disclosed in this report.

As used in the above, "person acting on behalf of the Commission" includes any employee or contractor of the Commission, or employee of such contractor, to the extent that such employee or contractor of the Commission, or employee of such contractor prepares, disseminates, or provides access to, any information pursuant to his employment or contract with the Commission, or his employment with such contractor.

NOTICE

This document contains information of a preliminary nature and was prepared primarily for internal use at the Oak Ridge National Laboratory. It is subject to revision or correction and therefore does not represent a final report.

The information is not to be abstracted, reprinted or otherwise given public dissemination without the approval of the ORNL patent branch, Legal and Information Control Department.

RELEASE APPROVED
BY PATENT BRANCH

76-59

DATE

SIGNATURE

000 001

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

PROBLEM

The operation of the Cold Trap Stands has been troublesome because of the difficulty in detecting and controlling the NaK levels in the surge tanks. As shown in the flow diagram, Reference 1, the NaK in the various loops is continuously pumped through the sump tank, a radical departure from normal practice. As a pressure difference is required to maintain the NaK level in each surge, the control of this pressure difference is critical in order to prevent flooding of the gas lines or emptying of the loop. Two schemes were tried for controlling this pressure difference without success. The first scheme used manual pressure control with spark plug probes to indicate the high and low level in the surge. An automatic helium blow down operated from the high level probe would inject higher pressure helium into the surge line when the high level probe shorted. This scheme was impractical as the probes shorted very quickly from condensed NaK vapor. In one week of operation, the probes were replaced seven times. The second scheme used manual pressure control with spark plug probes to fill the loops, a valve on the gas line just above each surge tank was closed trapping the gas above the NaK in the surge. The two times this scheme was tried, the trapped gas and NaK leaked out a spark plug probe or a Swage Lok fitting on the surge causing a fire. It was evident that a better method of indicating the NaK level was required which would be free of the shorting trouble of the spark plug probes.

FINDINGS

Based on A. L. Southern's experience, several thermocouple liquid Level Indicators shown in Figure 1 were built and tested. While the

indicators were not tested against another type of level measuring device in order to determine their precision or accuracy, they performed very satisfactorily and thus made the manual control of the pressure difference feasible and thus also, the operation of the Cold Trap Stands possible.

EQUIPMENT

A thermocouple indicator shown in Reference 2 had previously been tested by Southern. Based on his advice, the design was modified to the form shown in Figure 1. Eight thermocouples are welded to the inside of a 1 inch tube on 1 inch spacing. To minimize heat conduction cold air was forced down along side the thermocouples and exhausted out the 3/8 inch tube. The indicator was pushed through a Swage Lok fitting on top of the surge tank and positioned so that the thermocouples extended above and below the point the NaK level was to be controlled. As two indicators were used, one in each surge tank, the thermocouples were hooked up on a 16 point Brown strip chart recorder. Thermocouples 1 at the top through 8 at the bottom of one indicator were in the Check Loop Surge, while thermocouples 9 at the top through 16 at the bottom of the other indicator were in the Main Loop Surge.

CONDITIONS

The surge tanks were heated by calrods and held at about 1200°F. The cold air blowing through the indicators kept the thermocouples at about 300°F. It was found that as the hot NaK level rose in each surge tank, the thermocouple at the bottom, then the ones higher up would jump from 300°F to about 800°F, indicating the height of the NaK level. The

technicians found it convenient to stop the recorder on various thermocouples and to raise and lower the NaK level to that thermocouple. The response time as the level rose was within 2 seconds while the response time as the level fell was within 5 seconds.

Figure 2 records the operation of the indicators in Cold Trap Stand 2. The recorder was stopped long enough to raise the NaK level up into the Check Loop Surge so that t/c's 7 and 8 were hot, and t/c 6 was warm. The recorder was turned on and after 10 minutes with the Check Loop Surge level stable, it was possible to stop the recorder long enough to raise the NaK level up into the Main Loop Surge so that t/c's 14, 15, and 16 were hot. The recorder was turned on and after 40 minutes, it was evident that the level in the Main Loop was rising as t/c 13 was gradually getting hot. At 2032 hours, the technician dropped the level in the Main Loop Surge so that t/c 13 was cold. The t/c 14 also cooled off, the t/c 15, and finally the bottom thermocouple, t/c 16 started getting cold, so at 2040 hours, the technician raised the level so that t/c 15 was hot. At 2115 hours, the technician had to raise the level in the Check Loop Surge as t/c 7 was falling off in temperature.

It is readily evident that operation of the stand with pressure difference to hold the NaK level is a dynamic balance which requires careful adjustment of the pressure regulators. The thermocouple liquid level indicators make it possible to ascertain the level at any moment and the past history of the level as it gradually rises and falls.

⑤ BEFORE WELDING T.C. INSTALLATION,
PUT ON TUBE $\frac{3}{4}$ " SWAGelok NUT & FERRULE RINGS

⑥ END OF TUBE TO BE
PLUGGED WITH SAUREISEN

② S.S. PLUG FOR TOP
OF TUBE. TO BE
SILVER SOLDERED

④ SLIT SAW TUBE TO INSTALL
THERMOCOUPLES - AND WELD

THERMOCOUPLE LEVEL INDICATOR
COLDTRAP STAND #1
SK- - JMC-584

Figure 1

099 005

DISTRIBUTION

1. H. W. Savage
2. J. P. Lane
3. R. G. Affel
4. W. F. Boudreau
5. A. P. Fraas
6. J. M. Cunningham
7. W. R. Grimes
8. A. G. Grindell
9. J. J. Keyes
10. R. F. Hyland
11. J. W. Krewson
12. R. E. MacPherson
13. W. B. McDonald
14. W. D. Manly
15. P. G. Smith
16. A. L. Southern
17. E. Storto
18. C. M. Burton
19. G. H. Burger
20. A. M. Leppert
- 21-30. H. J. Metz (10)
31. M. J. Skinner
- 32-33. Central Research Library
34. Document Reference Section
- 35-36. Laboratory Records
37. ORNL-RC

DO NOT
PHOTOSTAT