The Reformer Information Network

The information provided by this network has allowed its participants to improve the reliability, as well as to decrease the operating hazards of primary reformers.

A.W. Ballantyne
Canadian Industries Ltd.
Courtright, Ontario, Canada

High pressure primary reformers are used extensively in modern, single-stream ammonia plants. The methane/ steam mixture is reformed to hydrogen and oxides of carbon at pressures approaching 500 lb./sq. in. gauge, with exit reformed gas temperatures approaching 1,600°F. In the late 1960's, after a number of major equipment failures in these reformers resulted in injuries to personnel, considerable plant downtime, and high equipment replacement costs, it became evident that information concerning unusual occurrences, inspection, repairs, and upgrading related to these reformers should be shared. In this way, it was believed that early warning could be given to others wishing to share such information, so that the risk of damage to personnel and equipment could be minimized.

The purpose of this article is to briefly detail the development of the Reformer Information Network, to describe its organization, and to outline the advantages which can be derived from belonging to it.

By 1969, several incidents of a serious nature had occurred. Failure of a transfer line in one plant led to serious damage to the structural steelwork and piping located on the top of the radiant section fire box. Failure of a number of riser tubes and catalyst tubes caused damage in varying degrees in a number of plants. These tubes had failed much before the predicted life of the tubes, based on design stress and creep failure parameters.

Organization and advantages of the network

At a primary reformer seminar held in Sarnia, Ontario in September 1969, which was attended by representatives from many of the users of M.W. Kellogg-designed high pressure reformers and with the active participation of the M.W. Kellogg Co., it was generally agreed that there was a real need to implement a system for exchange of information concerning failures in primary reformers. It was determined that the information which would be of value to partcipating companies would include:

1. Failures occurring in primary reformers, particularly those affecting safety and reliability
2. Modifications and improvements
3. Details of repairs

As a consequence of this meeting, the Primary Reformer Information Network was duly organized. Participating companies in the network were, and still remain:

Air Products and Chemicals Inc.
Allied Chemical Corp.
American Cyanamid Co.
American Oil Co.
Canadian Industries Ltd.
Commercial Solvents Corp.
Co-operative Farm Chemicals Assoc.
E.I. DuPont de Nemours & Co. Inc.
Gulf Oil Chemicals Co.
Central Farmers Industries, Inc.
Hill Chemical Corp.
Terra Chemicals International Inc.
Mississippi Chemical Corp.

In August 1971 African Explosives and Chemical Industries, South Africa, also became a participant in the network. These companies operate a total of 18 ammonia plants, all being in the 600- or 1,000 ton/day category and incorporating high pressure primary reformers.

The organization is very simple. Participating companies provide copies of reports concerning failures, improvements, and repairs to Canadian Industries Ltd. (CIL) which act as coordinators and distributors of this information to the other participants. Two forms are normally used to provide information concerning tubing failures and repairs. A completed copy of the first form, entitled "Tube and Manifold Failure Data," is shown in Figure 1. Note that the information occurred at the CIL plant. Note that the information includes the actual failure which occurred as well as the repairs which were made due to subsequent inspection following the shutdown of the plant. The second form, Figure 2, is entitled "Location of Reformer Defects, Repairs, Replacements and Failures."

In cases where the information contained in the forms does not fully describe the repairs effected, it is customary to attach a separate sheet, which is normally an extract from a shutdown report. A copy of a representative report is included as an appendix to this article.

The main advantages of participation in this network are:

1. That by reference to the reports received, warning is given of failure patterns which emerge in the various plants. This is particularly true of tubing weld defects which have shown similar patterns in a great number of plants. With this information, planning of shutdown inspection and

TUBE AND MANIFOLD FAILURE REPORT

1. COMPANY NAME - Canadian Industries Limited
2. PLANT LOCATION- Courtright, Ontario
3. COMPONENTS REPLACED OR REPAIRED OR DEFECTS NOTED:-

	NO. BY LOCATION	DATE	REMARKS
CATALYST TUBES -	"A" Bank No. 4 Tube	March 17, 1971	1½" crack 11' up from Btm. Manifold
RISER TUBES -	"B" Riser	March 17, 1971	Removed due to excessive bowing
MANIFOLD ITEMS -	7 Weld-o-let to catalyst tube welds were repaired.		

4. FAILURES -

	CRACKING		BORE OXIDATION		
	NO. BY LOCATION	DATE	NO. BY LOCATION	DATE	REMARKS
CATALYST TUBES -	"A" Bank No. 4 Tube	Mar. 17, 1971			1½" crack 11' up from btm. manifold
RISER TUBES -					
MANIFOLD ITEMS -					

5. DATE OF REPORT -

6. LOCATION OF FAILURE, REPLACEMENT, REPAIR OR DEFECT - To be indicated on Location Diagram for submission with report.

7. SUBMIT REPORT TO ATTENTION OF WORKS ENGINEER, CANADIAN INDUSTRIES LIMITED, P.O. BOX 1900 COURTRIGHT, ONTARIO FOR REVISION OF FAILURE SUMMARY AND TRANSMITTAL TO PARTICIPANTS.

Figure 1. A Tube and Manifold Failure Data form.

repair is facilitated.

2. Reliability and safety of the operation of the reformer can be improved when modifications made by any one of the participants can be incorporated in the furnace design in any of the other plants.

The above two items refer to short term advantages. A further item, which has longer term implications of great importance to all participants, is the evaluation of the need to retube sections or the whole of the tubing in the primary reformer. In order to attempt such an evaluation and base the evaluation on the experience of a number of similarly designed and operated plants, it is necessary to develop failure patterns. In 1970, Allied Chemical Corp. undertook the task of developing such data. The information produced as a result of this effort *(1)* is available to all network participants, as well as to other organizations which have a particular interest in primary reformers.

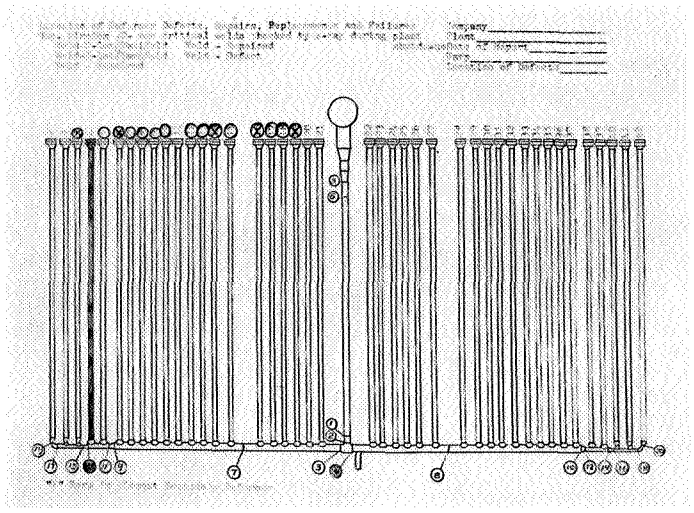


Figure 2. A Location of Reformer Defects, Repairs, Replacements and Failures form.

What of the future?

Since safety and reliability are virtually synonymous when it comes to high pressure primary reformers, the network will continue to upgrade the type and the detail of the information provided to its participants which will help improve the reliability and decrease the operating hazards of reformers. Information on such matters as tubing weld procedures, techniques and equipment used for assessment of tubing life, modifications to the design of the transfer line, and use of improved burners and firing techniques, will be of great assistance in this regard.

A by-product of the presentation of this article may be that companies who are not presently participating in this network may wish to join. While there are no formal restrictions as to participants, all current participants would have to agree to any enlargement of the network. For ease of administration, it would be preferred if any company wishing to participate would address their enquiries to Canadian Industries Limited, P.O. Box 1900, Courtright, Ontario, Canada. CIL will then arrange for the necessary clearance of new participants and act according to the wishes of the existing network. #

Literature Cited

1. Salot, William, "Anticipating Reformer Tube Life in Normal Exposure Service," paper presented at AIChE 70th National Meeting, Atlantic City (August 29-September 1, 1971).

Appendix

CIL Lambton Works

Maintenance Work in "Primary Reformer"
During March, 1971 Shutdown

The reformer was shutdown on March 17, 1971 due to a leaking tube at the west end of "A" row. On entering the reformer, it was found that the catalyst tube A-4 had a leak on the north side, approximately 11 ft. up from the bottom header. The crack had opened up to a length of approximately 1-1/2 in.

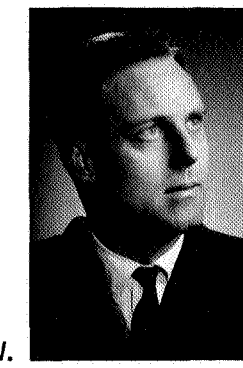
The tube was removed by cutting off the tube at 6 ft. above the bottom header and lowering the tube down into the furnance and then out through a hole in the east wall. The tube was then cut at the weld-o-let, and the final piece removed. This entire process took approximately 1-1/2 hr.

The arch brick around the tube had to be removed and the brick from the floor. The floor panel was cut out and the cutting of the tube was done using carbon arc. "B" riser was also replaced at this time due to excessive bowing and hot spots. A similar method to removing the catalyst tube was used.

Both bottom welds on the riser and the catalyst tube were made using "Inconel 625" wire for the TIG root pass and "Inconel 112" rod for the M.M.A. weld out. All other weld work in the furnace was made using "Inco A" rod.

A number of welds were x-rayed and two showed defects. A-4 and B-7 were both repaired and re-x-rayed and found OK. Please see x-ray survey sheet for welds checked and results.

The insulation from the header on "A" and "B" bank was removed for inspection of the weld-o-let to manifold welds. A total of seven tubes had cracks in the welds that had opened up. These were ground out and re-welded. Some tubes had cracks on both sides of the tube. In general, the cracks from previous inspection of August 1970 had not progressed as much as had been expected.



BALLANTYNE A.W.