International Conference and Workshop on Reliability and Risk Management

September 15–18, 1998
Adam's Mark Hotel
San Antonio Riverwalk, Texas

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International Conference and Workshop on Reliability and Risk Management

This volume is one of a series of publications available from the Center for Chemical Process Safety. A complete list of titles appears at the end of this book.

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POSTER SESSION

Risk-Based Inspection/ Reliability-Based Maintenance

Chair **Harold Thomas**
Rohm and Haas

Achieving Plant Performance Goals by Applying Reliability Centered Maintenance

Della Wong and Don Sommerstad
Strategic Initiatives, NOVA Chemicals Ltd., Red Deer, AB, T4N 6A1

Nova's Joffre site has been in operation for over 19 years and Nova has become increasingly aware of the challenges in achieving and maintaining reliable plant performance. Reliability Centered Maintenance (RCM) was adopted at the Joffre site during a "re-engineering" effort several years ago. RCM was initiated by a business decision to excel at low cost production, a part of which required maintenance teams to research and develop best practices for reliable operation. The benefits of RCM were quantified/validated as part of a recent benchmarking analysis. It indicated that over 50% of maintenance's tasks and labour hours could have been prevented in our $1.5 billion petrochemical complex.[1] Significant savings could be realized with implementation of RCM. NOVA views RCM as an analytical tool that defines and allocates the "right" maintenance resources.

Equipment reliability is a function of

- inspection records
- design data
- maintenance records and
- management of work procedures.

These are direct inputs into the RCM process. Using a qualitative risk methodology (FMEA) as the framework, RCM focuses on the functionality of equipment in the desired operating environment. By focusing on the function, maintenance tasks are selected to improve the reliability (availability) of process equipment. The implementation of appropriate maintenance allows equipment to be operated reliably for the full life cycle of the plant. The FMEA process is used to identify conceivable failure modes of the components. Results are formatted in a 5x4 risk matrix which was developed in-house. This matrix identifies intolerable risks by incorporating criteria in economic terms, environmental, personnel safety and governmental intervention. It is now used to logically and methodically evaluate equipment performance risks. Follow-up actions are specifically linked to the FMEA results in order to minimize the total risk.

1 WCM Benchmark Analysis of Joffre, March 1998 HSB

A particular case history of a RCM analysis on the Ethylene Plant 1superheater system is discussed herein.

CASE HISTORY

In this particular case history of an RCM analysis on Ethylene Plant 1's superheaters SH-902 A/B. These two superheaters A and B are vertical cylindrical vessels which superheat saturated steam to 400°C or 752°F (see Figure 1).

The vessels consist of a cylindrical firebox with a convection section

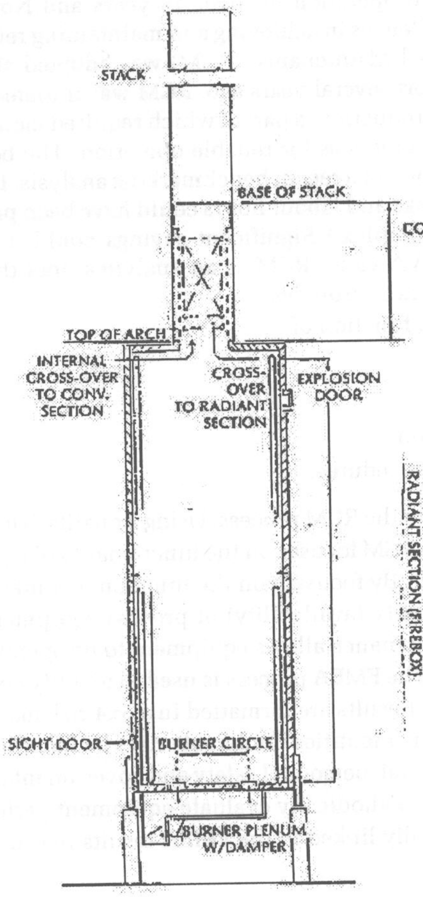

FIGURE 1. Superheater

and stack mounted on it. The superheaters burn plant fuel gas.[2] On Septem-

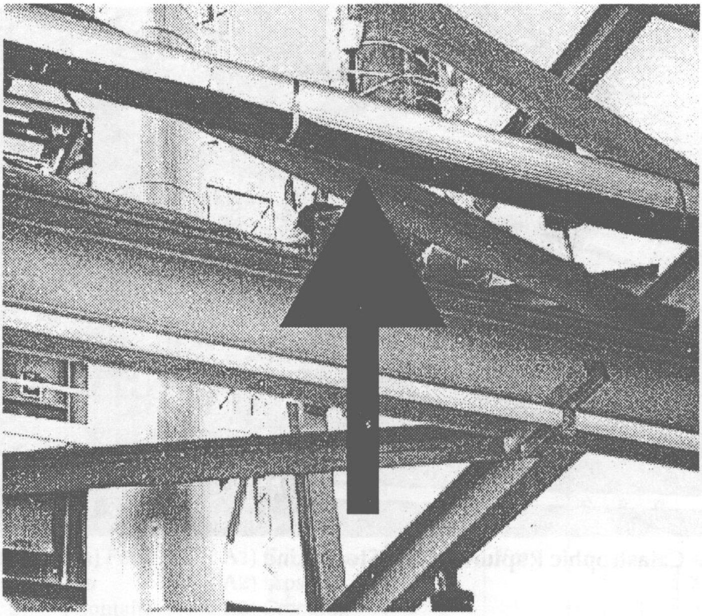

FIGURE 2. Location of 20" superheater outlet line in the piperack.

ber 24, 1996 Superheater 902B was put online after maintenance activity. During the warmup, the pressure and temperature were gradually increased to setpoint (400°C), when a large noise and chatter were heard. The plant was evacuated. Upon investigation, the 20" superheater outlet line had catastrophically ruptured (see Figure 2).

The 16" opening (see Figure 3) released 600 psi steam until the operators isolated the superheater. No personnel injuries resulted. However, significant damage and production loss was incurred. The incident investigation recommended that mechanical integrity of the superheater envelope be evaluated.[3] As well, the Olefins Reliability Support Team (ORST) was requested to identify areas of inherent unreliability and make recommendations for reliability improvement.

ORST initiated Reliability Centered Maintenance on the superheater system to support the plant's objectives. The RCM cost $35K and ran over 4 months with 5 RCM team members and resulted in thirty-eight (38) recommendations. The process steps were as follows:

2 Olefins Process System 902 Manual, Section 2.0, p.1
3 Incident Report, Ethylene 1, SH-902B Line Rupture, September 24, 1996

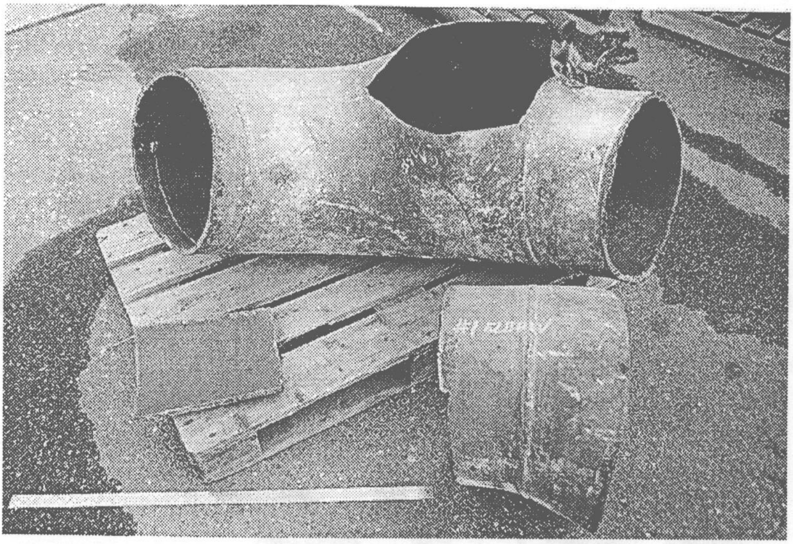

FIGURE 3. Catastrophic Rupture of 20" Steam Line

STEP 1: FMEA

The RCM team was assembled with operations, maintenance and engineering disciplines familiar with the superheater unit. They agreed upon the deliverables of the RCM analysis which were to:

1. Achieve a 99% Olefins Plant on stream time, which would require zero lost production due to superheater availability, and 99% reliability during process upsets and plant start-ups and shutdowns.
2. Achieve zero major incidents in the superheater area.
3. Eliminate unplanned production reductions due to equipment degradation.
4. Verify the adequacy of the preventive maintenance program to ensure high reliability at an acceptable cost.

Next, the desired functionality and the associated performance standards were defined. Then, the team divided each superheater into logical sub-systems: fuel gas (main burner) system, the natural gas (pilot gas) system, the acid gas system, the combustion air system, the purge steam system, the firebox system, the steam piping system, and the burner management system.

All of these systems were then further divided into components and a list was developed itemizing all equipment within the boundary limits. Each component was analyzed for failure to perform its function with all of the possible causes itemized. Being cognizant of evident or hidden failures