Summary

This thesis is written as final assignment for the MoSHE education. The main question to be answered in this thesis is:

How well is Koch managing the barriers that are meant to prevent incidents from happening?

The thesis is divided as follows:
1) Literature review on barrier theories and safety management theories (chapter 2).
2) Defining elements and management delivery systems within the safety management system that is used by Koch HC Partnership (chapter 3).
3) Scenario case studies and discussion (chapter 4).

The literature review starts with the description of the hazard-barrier-target theory from Haddon. Multiple classifications of barriers (types and systems) are discussed in literature. The classification applied to barriers defined in the case scenarios is as follows:
- Defensive (in front of hazard/loss of control) barrier versus protective or mitigating (in between hazard and target).
- Hardware/software/physical barrier versus people/behavior/non-physical barrier.
- Working, failing or missing barrier.

When barriers are implemented in event and causal factor chains (events – loss of control – effect to target) so called bow ties are formed. The literature review continues with the description of typical structure of safety management systems (SMS). The SMS as defined by Koch (compliance, including health and environmental elements) contains similar elements as defined in a typical SMS. The management delivery systems are defined from the safety management system. These delivery systems are used in the barrier analysis to judge the performance of the safety management system.

To be able to answer the main question in this thesis, three case scenarios have been built using data from the incident reports that were generated during the construction phase of expanding the Rotterdam splitter into the Rotterdam refinery (operated by Koch HC Partnership):
- Scenario 1: material and matter (parts) out of control (high chance – low effect)
- Scenario 2: falling objects from heights (high chance – low effect)
- Scenario 3: hydrocarbon material outside closed system (low chance – high effect)

The scenarios have been built using the Taproot© tool which is capable to visualize the bow ties including the barriers. This tool is already in use for incident investigation within Koch HC Partnership. Barriers that were working, failing or missing have been formulated. Some barriers are defensive (in between hazard and loss of control); others are protective (in between loss of control and target). Reviewing the barriers shows that multiple management delivery systems were failing (during the construction phase of the expansion).

By listing the management delivery systems that belong to the failing or missing barriers, it was possible to identify what parts of the safety management system are in most need of improvement:
- Job hazard analysis
- Last minute risk analysis
- Procedure
- Training/competence
However, the most recent turnaround showed that the efforts put in improving the first three systems have resulted in success. Combined with the outcome of the safety surveys it shows that Koch’s overall management system is functioning well. The fourth system, training/competence, needs more analysis to address and improve.

Overall the problem definition can be answered with the following: Koch has the delivery systems in place to manage the barriers. Therefore the safety management system is capable in supporting the barriers. However during construction it appeared that the delivery systems are under more pressure than during production, which leads to failure of the barriers. The delivery systems that need most attention are being defined (see list on former page) and there have already been taken successful actions to improve these systems during the turnaround of 2006.

At the end of this thesis some recommendations are listed in order to continue working with some of the ideas mentioned in this thesis: Continue to use barrier analysis in incident investigations to be able to identify elements that are in need of improvement within the existing safety management system. Furthermore, continue to create specific job hazard analysis for all work packages to be able to develop risk mitigations for safe work permits. Finally make sure that these elements are included in a SHE plan for future projects.

It has been very useful for the organisation to look at incidents in the way it has been discussed in this thesis. Probably the most valuable outcome of this analysis is the identification of learning points for future expansion projects.

All information regarding incidents and safety performance of Koch HC Partnership BV mentioned in this thesis should be treated confidentially and cannot be used or referred to without approval of the author.