

USE OF THE SAFETY CASE AS A TRAINING TOOL TO DISPERSE CORPORATE KNOWLEDGE

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Safety Case requirements are established in a number of jurisdictions around the world as a tool for authorities to assure themselves (and hence the community) that residual risks to the public adequately controlled. For a business to satisfy such requirements many years of effort are needed.

Australian Vinyls management saw the challenge of complying to Victoria's new OH&S (Major Hazard Facilities) Regulations 2000[1] as an opportunity to improve the business rather than a regulatory burden. Foremost in management's mind was the potential use of the Safety Case as a training tool to first capture, then disperse corporate knowledge about process safety fundamentals[2].

Keywords: Safety Case, corporate knowledge, Longford, Basis of Safety, Piper Alpha, safety training, Permit to Work,

INTRODUCTION

Victoria's OH&S (Major Hazard Facilities) Regulations 2000[1] were enacted by the Victorian Parliament following the explosion and fire at the Esso Gas Processing Plant at Longford[3] in which two people died, eight were injured and supply of natural gas to the whole state was cut for between 9 and 19 days[4].

The regulations call for a Safety Case to be prepared which must meet a number of requirements as part of a licensing regime for major hazard facilities. These requirements include:

- Summary of Safety Management System including demonstration of integration and comprehensiveness
- Method used to identify *ALL* hazards and potential major incidents
- Control Measures and a demonstration of their individual and collective adequacy
- General descriptions of:
  - activities
  - products
    - all dangerous goods
    - main units of process equipment
    - description of proposed changes
    - plans
- Weather information
- Emergency plans
- Signed statement from Chief Executive

Australian Vinyls (AV) agreed with the Victorian WorkCover Authority (VWA) to take part in an Exemplar program with the 140 ktpa Laverton PVC Resins Plant. AV's motivations for this were:

- To set ourselves in the best possible position to obtain a 5 year licence (the maximum available under the legislation)
- To have the Safety Case become a training tool, capturing information and wisdom

- To develop a process which could be integrated into our modification control system to ensure corporate knowledge is not forgotten
- To ensure the Safety Case was a working and living document owned by AV
- To influence Safety Case development in Victoria
- To develop our Safety Case process early on
- To release the key process engineering people for plant capacity increase design.
- To use the Laverton Plant due to its strong base of inherent process safety features
- To use learnings in the Safety Case for our nearby Altona Plant.

VISIT TO THE UNITED KINGDOM

As an Exemplar plant starting work before the legislation had come into law and before any guidance notes had been prepared, AV were unsure of what the end product would look like. The author undertook a visit to the United Kingdom to attend two conferences in late March and early April 2000. These were the **Safety Cases: Cross Industry Comparisons of Best Practice** and **HAZARDS XV**. These conferences and the contacts made were able to provide clarity of vision. The key points of this vision were:

- 100 pages maximum[5]
- To be clear and concise so that it could be read in a shift[5]
- Make use of graphics - Cause/Effect or "Bow-Tie" diagrams[6]
- Demonstration is key to the case so detail must be referenced outside[7]
- Make use of "sound engineering judgement"[8]
- Workforce involvement[8]
- A balance between qualitative and quantitative analysis required[8].
- The Safety Case must be complete to clearly demonstrate[7]
- Show our rationale[7]

This was even more critical as we found that VWA were not able to offer help in setting this vision. Our analysis suggested four causes for this:

- They did not know themselves where this was going
- They genuinely were developing and growing us
- They wanted to push the "bar" as high as they could and the highest point would be the one we set for ourselves
- Due to the licensing function of VWA there needed to be a distancing from a legal viewpoint

THE TRAINING ENVIRONMENT AT THE AUSTRALIAN VINYLS LAVERTON PLANT

Prior to July 2000 the plant operated 4 continuous shifts of operators working a nominal 40 hour roster including rostered overtime. During 1999, in Enterprise Bargaining Agreement (EBA) negotiations, this was changed to a 5 shift operation involving employment of 5 new operators and building in a formal training day every 5 weeks.

This provided the framework for future training structures at the plant and allowed the transfer of knowledge from a small expert base to all people on the plant[2]. Training packages have been developed around the arguments used in the Exemplar Safety Case to demonstrate the adequacy of Control Measures and which use the Safety Case document as a data source.

Further development of the training materials will take place as focus is placed on critical control measures using incidents (both local and international) as the hooks for learning.

TOOLS USED IN THE EXEMPLAR SAFETY CASE TO DEMONSTRATE ADEQUACY

The Exemplar Safety Case arguments have been developed around two key tools. The first that the plant has a well developed Basis of Safety (see figure 1). The second is the demonstration of links between hazards and control measures by the use of "Bow-Tie" diagrams[6].

BASIS OF SAFETY

The focus of our approach to safety is to prevent failure of critical controls and maintain the integrity of the detection systems and our emergency response capability. We do this through a concerted and sustained effort to create and maintain:

Operational Integrity	This includes operator and maintainer skills, knowledge and understanding, procedures for normal and foreseeable activities, Permit to Work, contractor control, plant modification control, training. These systems form the core of the Safety Management System.
Process Integrity	This includes control of vents, drains, backflow via utilities and other process interfaces with the environment, recipe control, overfill and overpressure protection, DCS integrity.
Plant Integrity	This includes engineering standards for design, procurement and construction, pressure vessel, pipework and relief valve management, inspection, emergency power.
Response Integrity	This includes systems to detect loss of containment, emergency plans, and various response mechanisms to mitigate the consequences and a culture of learning from unusual events.
Layout	This includes the important features incorporated at the earliest stages of the design process that mitigate the effects of major incidents.
Siting	This includes even earlier decisions that mitigate the consequential effects of a major incident on the local community.

This is summarised in figure 1, which shows these features acting as the barrier between the hazards of VCM, and the safe quality tons that we must produce to be a viable business.

BOW-TIE DIAGRAMS

Called a Bow-Tie diagram because of its shape, the diagram graphically conveys the relationship between hazards, control measures, and incidents. Figure 2 illustrates a generic Bow-Tie.

The causal (left hand) side of the Bow-Tie distinguishes the basic hazards from resultant hazards, and clearly identifies the control measures that are associated with a large number of hazards. Critical control measures are also highlighted on each Bow-Tie diagram.

The consequence (right hand) side of the Bow-Tie diagrams explains the possible consequences of each incident, and the control measures that prevent escalations.

Two different consequence diagrams were prepared for VCM, one for a liquid VCM release, and one for a vapour VCM release. In the Exemplar Safety Case, these have been "broken" off the Bow-Tie, and presented on separate sheets. This has been done so the diagrams can be read more easily.

Figure 3 illustrates a hazard scenario for the causal side of a loss of containment from a storage tank of VCM through a hole of greater than 150mm as prepared for the Exemplar Safety Case and figure 4 illustrates the consequence side of the resulting liquid VCM release.

THE TRAINING PROCESSES

BASIS OF SAFETY

The Basis of Safety training has been delivered using a lecture style format to provide an overview of the physical properties of VCM and its inherent dangers. This has then focussed on the Siting, Layout and Plant Integrity (refer to Figure 1) features used to control and mitigate the various hazards. These sessions were lead by the recognised expert on VCM and PVC process engineering and production with many years experience both in Australia and Europe.

BOW-TIES

The Exemplar Safety Case document was introduced to the site in a more interactive format[9]. The initial overview was provided in lecture style. Establishing the details of the case was worked through in small groups working on separate sections of the document and reporting back to the main group. This was followed by a group exercise at brainstorming hazards and control measures culminating in defining a single pathway on one Bow-Tie.

From this point individuals now have the skills to read through the Exemplar Safety Case document to understand the Control Measures they interact with every day and the hazards that are being controlled. And more specifically, understand the Bow-Ties and their use as a communication and demonstration tool clearly showing the links between individual hazards and the control measures that act as barriers leading to a major incident.

TRAINING IN HAZARDS AND CONTROLS

By the time this paper is presented the next stages of training will have been designed and some will have been delivered. A series of learning sessions are planned based around a

group of control measures and hazards. These sessions will use case studies like Flixborough and Piper Alpha as well as local examples, and link back to appropriate Bow-Ties and to the Basis of Safety. The first of these is awareness training in Permits to Work.

PERMIT TO WORK

The Hazard Identification and Safety Assessment process undertaken for the Exemplar Safety Case produced for the Laverton Plant during 2000 highlighted the importance of the Permit to Work system in preventing Major Incidents occurring. In the 25 VCM related Major Incident scenarios developed, the Permit to Work system appears as a Critical Control Measure in 13 of them. As a result, a complete review of the Permit to Work system has been undertaken, after comparing our current systems with 7 different local and international standards, procedures and codes of practice[12-18]. This has resulted in the development of a new Permit to Work System.

Training in the new system has been broken down into three packages:

- Awareness Training
- User Training
- Authoriser Training

Awareness Training

AV has concluded that all personnel that undertake work on the plant must have an awareness of the Permit to Work system. This includes the operators who perform the isolations, the engineers who specify the work, the Shift Mangers that authorise the work, and the Management Team that counter authorise higher risk activities.

In the first stage of training a package has been designed to increase awareness and to provide understanding as to why such systems are necessary. The format prepared involves a number of different learning methods to reinforce the importance of the message over a three-hour period.

The Manufacturing Manager who is the line manager responsible for the system[10] introduces the first hour. This hour is centred around a Brian Appleton training video on the Piper Alpha disaster[11]. At the conclusion of the segment watched, the group is asked to brainstorm the lessons learnt. The Permit to Work issues are highlighted and retained for later use.

The second hour is lead by the then Plant Manger involved in an incident on the Laverton Plant in November 1998. A case study has been prepared of the incident and the group is broken into subgroups of 5 to 9 people to look at the case study and prepare issues as they see them. The subgroups are brought back together to summarise their findings which are once again retained for later use.

The third hour is lead by the Safety Case Manager who links the importance of the Permit to Work system to the prevention of Major Incidents. Changes coming with the new system are highlighted. A fitter then appears and asks the Shift Manager present in the

training session to authorise a Permit to Work for removal of a piece of plant. Multiple copies of the Permit and associated Job Safety Analysis (JSA) are provided to the group and the Shift Manager leads the group to act as a collective Shift Manger to authorise the Permit to Work on site (including checking the isolations).

To summarise the session the group returns to the training room to review the permit they have completed against the things they learnt from the Piper Alpha video and the plant case study. And the session concludes with the final few minutes of the video that provides anecdotes of two survivors of the Piper Alpha disaster.

User and Authoriser Training

The training materials developed for those that use the Permit to Work System is designed to highlight the specific requirements and considerations that must be taken in planning a job, recognising hazards and planning specific controls to prevent injury and incidents.

The specifics of the training have yet to be designed and are not planned at the time of preparing this paper. However it will utilise similar techniques to those described in the previous section *and* require individual competency assessment.

Training for Authorisers is the same as that for users, with the additional requirement of an extensive verbal test of their working knowledge of the system and demonstration of their ability to discharge their responsibilities by use of worked examples in the field.

RESPONSES TO THE TRAINING PROGRAMME

OPERATORS

The Operators response was most favourable to those sessions that involved interaction and active participation. The operators give extra credence to the training when it involves interaction with the plant.

In particular the Awareness training on the Permit to Work System provided an overview of a system that they seldom interacted with (other than to perform isolations), and an understanding of the burden placed on Shift Managers.

However by far the biggest benefit was the realisation in the Operators minds that Safety was really the highest priority and that production *is to* be compromised if there are safety issues.

Criticisms reported included:

- A concern that individuals were identified in the local worked example during the discussions. This concern was not expressed by those involved who had all been involved in the development of the Case Study. (Also a briefing had been undertaken with the Industrial Chaplain should any issues arise).
- Use of check sheets by the work shop facilitator to see that the group had picked up all the points. One particular shift felt that this was poorly done. This process was modified for later groups and was no longer a concern.

MAINTAINERS AND ENGINEERS

This group interact with the Permit to Work system on a daily basis. As such they are more keenly interested in the changes proposed from the current system. For them the key benefit was that new starters now have a framework for learning about the Permit to Work System and were not required to learn it by absorbtion[19] or an unhappy event. They, like the operators, responded to interactive sessions, and walking around the plant more favourably than lectures.

PLANT MANAGEMENT

The most useful aspects for plant management were that out of the sessions changes occurred on the plant. As a result of the exercise of signing on a permit on the plant less than desirable equipment labelling was found which was corrected. Also problems with leaving some equipment spares isolated for extended periods were picked up.

THE REGULATOR

The Regulators Safety Case Officer has participated in a number of the training sessions to see how the Safety Case is being utilised and to see how well the critical hazards and control measures are understood by everybody on site. This has enabled the Regulator to see at first hand the benefits of Bow-Ties in particular. The key issue for the regulator was gaining an understanding of how we caught up with those people who missed the scheduled training sessions.

CONCLUSION

In preparing a Safety Case to meet regulatory requirements, Australian Vinyls has seen the opportunity to use the Safety Case as a tool that captures and retains vital corporate knowledge. This knowledge can be from initial design, incidents both within the company and outside it, and from the collective experience of those in the Organisation.

The “Bow-Tie” tool is a very useful means for communicating the knowledge about hazards that can lead to major incidents and the control measures undertaken to control the risks. Information in the Bow-Ties is shared via a series of learning sessions that focus on the Critical Control Measures and that can be designed to maximise the opportunities to learn.

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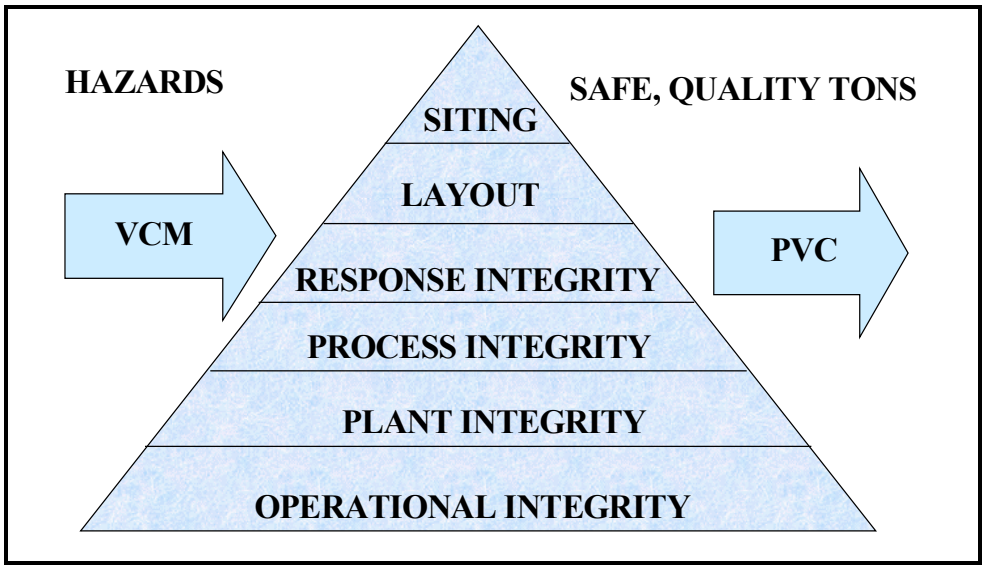

Figure 1. Basis of Safety

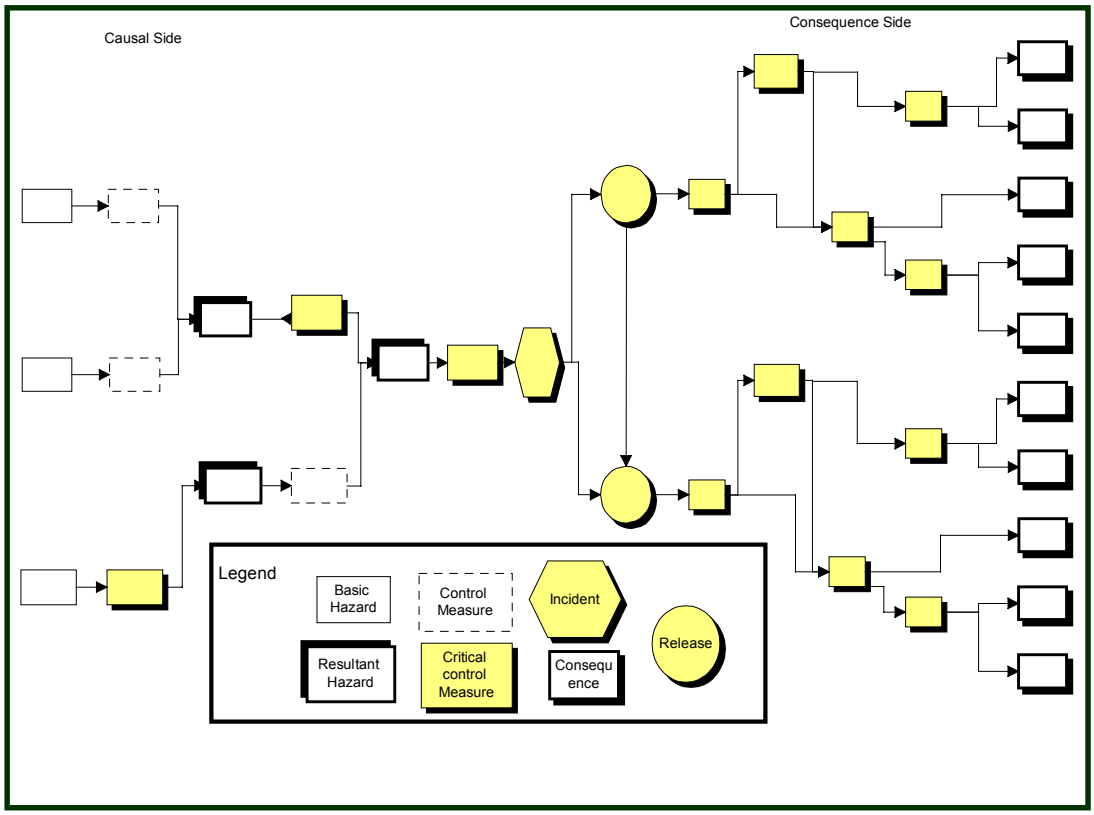

Figure 2: A Generic Bow-Tie

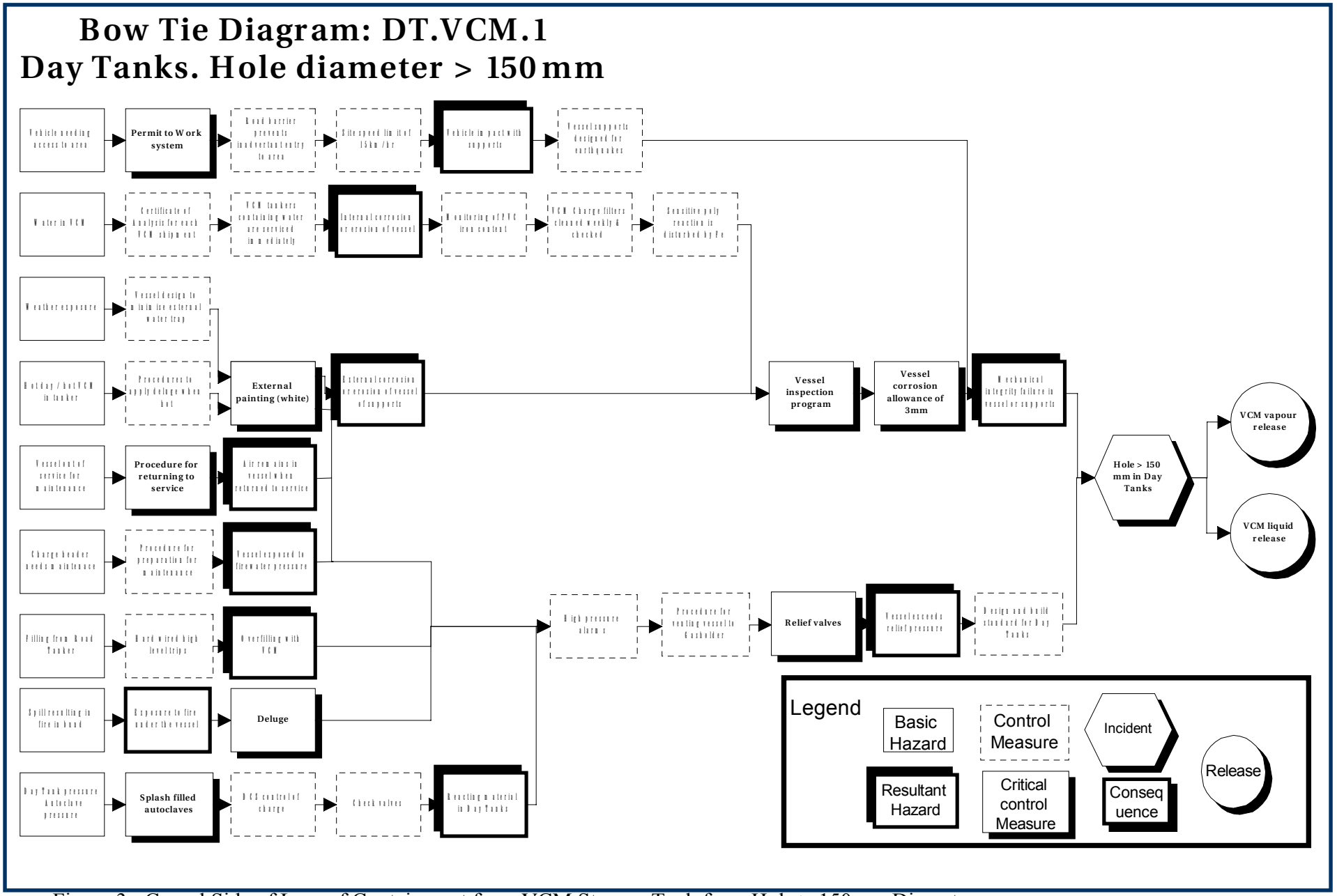

Figure 3: Causal Side of Loss of Containment from VCM Storage Tank from Hole > 150mm Diameter

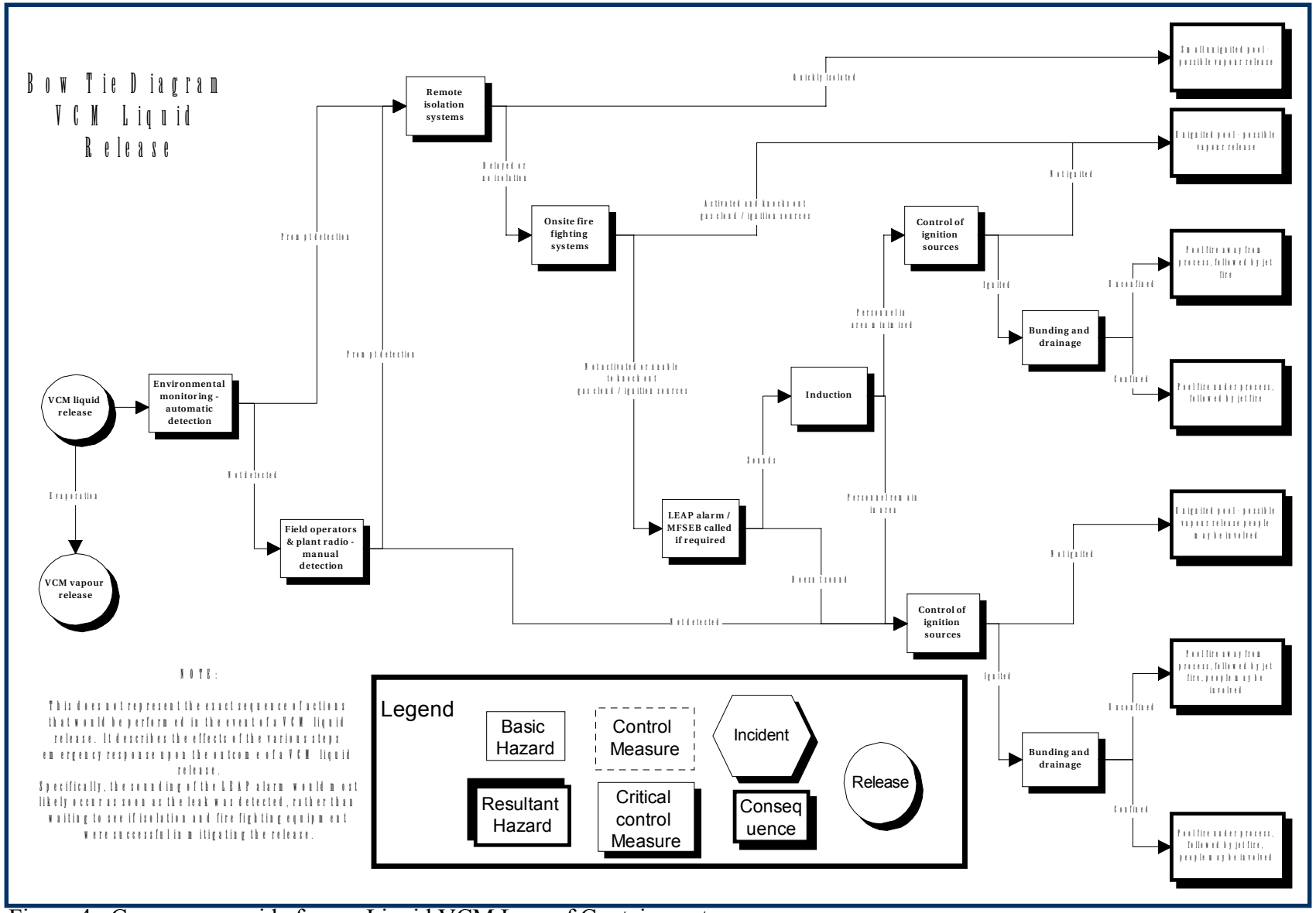

Figure 4: Consequence side from a Liquid VCM Loss of Containment