Impact of the Esso Verdicts on Engineering Practice

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When a jury in the Supreme Court of Victoria found Esso guilty of 11 criminal charges under the Occupational Health and Safety Act, it was essentially passing judgement on the company's management performance. It found that the company had failed, in several ways, to provide and maintain a safe workplace. Some of the charges have direct and strong bearing on engineering practice at not only the Longford gas plant, but also at all other complex, hazardous process plants in Australia.

Behind the guilty findings for these charges lie judgements with respect to the community's expectations of performance by engineering practice in delivering workplace safety at complex process plants.

The Rupture of GP905

The vessel that exploded at Longford was a shell and tube heat exchanger, GP905, located in Gas Plant 1. In normal operation, cold rich oil entered the vessel at 60°C and exited at 100°C, being heated by a counter flow of hot lean oil entering at 230°C and exiting at 120°C. It was a "hot service" vessel, and not expected to ever experience temperatures lower than ambient.

Heat transfer between the two process streams was achieved in other heat exchangers as well as GP905, as depicted in Fig. 1. The cold rich oil entered the first of these exchangers at or below minus 30°C.

The prosecution argued that GP905 exploded as a result of:

1. flow of hot lean oil ceased due to a pump shutdown, and remained so for at least three hours
2. flow of the cold stream (at first cold rich oil and then cold hydrocarbon condensate) continued
3. without the heating medium, GP905 dropped in temperature to below minus 30°C which was way below its minimum design safe operating temperature
4. the weld metal of GP905 became brittle at the low temperature and susceptible to fracture if unduly stressed
5. approximately 4 hours after the pumps shut down they were restarted and flow of hot lean oil was re-established into GP905
6. hot lean oil entered the cold exchanger, producing sudden thermal stresses and causing a weld to crack

7. the vessel had been kept at its normal operating pressure and, upon the weld cracking, violently ruptured

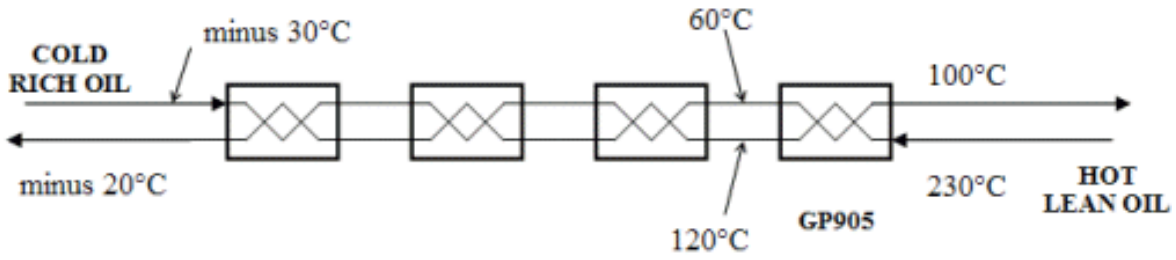

Fig. 1 – Extremely simplified schematic arrangement of GP905 & other exchangers (temperatures are nominal only, for normal operations)

Charge 1 - Failure to Conduct Any Adequate Hazard Analysis

The OH&S Act requires employers to identify, as far as is practicable, workplace hazards. Absolute safety is seen as an unachievable ideal, and much hangs on that phrase "as far as is practicable". For any alleged breach, a court will consider the accepted methods, standards, codes of practice, safety management systems and so on utilised within the industry in question. For the jury to find the company guilty on this charge, it had to be satisfied on two "elements" of the charge, namely:

(i) the hazard of cold embrittlement existed

(ii) the company had a practicable means of identifying the hazard, that it did not employ

The prosecution case for element (i) was fairly simple:
If the flow of heating medium ceased and the flow of cold medium continued, then GP905 would reach temperatures lower than its minimum design temperature and become dangerously cold. This was the hazard.

Their case for element (ii) was that a HAZOP study was the tool available to the company by which it could have identified the hazard. Moreover, a HAZOP study performed by a competent team could be expected, beyond reasonable doubt, to have identified the hazard. A HAZOP on Gas Plant 1 had never been done.

Since a guilty verdict was found for this charge, it follows that the jury considered both these elements proven.

HAZOP - HAZard and OPerability Study

HAZOP is a methodology widely practised in process industries to identify likely hazards in complex, extensive process plants. A team systematically examines the plant design, considering the consequences of deviations from normal conditions at each item of equipment. The team always includes process engineers familiar with the plant.

In pretrial hearings, the judge ruled that the prosecution could not merely assert that the hazard was identifiable, but it also had to specify the particular method the company should have used to identify the hazard. Hence, HAZOP became an integral component of charge 1.

HAZOP in Australian Case Law

The term "HAZOP" has been referenced three times in Australian case law, prior to the Esso trial - once in the Environment Court of NSW, and twice in the Industrial Relations Commission. Although in each instance HAZOP was a minor component of the overall case, the record shows that the law recognizes the HAZOP methodology as an established and defined engineering and management tool, although it is not a statutory requirement.

With the Esso case, HAZOP has been examined in detail by a jury, and their verdict of guilty for charge 1 elevates the position of the methodology in Australian law. A jury has now made a judgement on the expected performance level of a HAZOP study, which in turn implies an expected performance level of the HAZOP team members.

Impact on Engineering Practice

The Law loves a precedent. Having now established that HAZOP can be expected to achieve a particular outcome, it becomes easier in future cases to pursue the allegation that an employer failed to identify a hazard in a complex plant.

In its defence, Esso called an expert witness who maintained that the outcomes of a HAZOP are neither predictable nor guaranteed. He argued that much depends on the quality of the individual team members. This is plausible, but somewhat academic – the jury has effectively taken the question out of the experts' hands. The jury has said that the hazard of cold embrittlement was identifiable and should have been identified. That is essentially a statement of the community's expectations of the experts' performance.

Ongoing Offence

Charge 1 was alleged to have been an ongoing offence from 1 Jan 1993 to 25 Sept 1998, the day of the explosion. There was no need for the vessel to have actually ruptured for this charge to be proven. It was not even necessary for the hazard to have been realised, that is, for the vessel to become brittle. The hazard - the potential of cold embrittlement - existed continuously during normal plant operation. So the offence was that the company failed to perform adequate hazard analysis on a continuous basis for the entire period of more than five years. The charge could have stood up in court at any time in that period and did not depend on the tragic incident of 25 Sept 1998.

Potential Impact on Engineers

Charge 1 essentially targeted the performance of company management. Engineers might like to consider the following scenario - that the HAZOP was done, but did not identify the hazard. In that situation, would individual team members be joined with the company in alleged breaches of the Act?

HAZOP team members must now keep in mind that their performance may be subject to inspection and judgement by a court. This applies not just to future HAZOPs, but also to past HAZOPs whose results have current effect.

Charge 9 - Failure to Monitor Plant

Charge 9 was that the company failed to adequately monitor the health of the plant. The prosecution claimed that the tools to do so were the control room instruments and charts in the hands of experienced process engineers. The essentials of this charge were:

(i) crucial chart recorders were not functioning
(ii) there were no on-site engineers

The non-functioning recorders were associated with the very parameters that were needed to diagnose the process upsets. These would have been invaluable to investigators after the event. For diagnosing the dangers from abnormally cold vessels, the most important parameter was the temperature of GP905, the chart recorder for which was not functioning. However this instrument did not register sub-zero temperatures, so its usefulness, even if working, was limited.

Heavy icing was seen on GP905's pipework - conclusive evidence that its internals were at less than 0°C. This was enough data for "any competent engineer", in the prosecution's words, to recognise the danger and advise the operators to not shock the vessel. However, no such person was available on site to make this assessment. Engineers were based at head office in Melbourne, 200 km from Longford. They were accessible by phone, but the prosecution claimed that the data necessary to diagnose the process upsets was not available, as the relevant recorders were not functioning.

The likely impact on engineering practice of the guilty verdict for this charge is not as clear as for charge 1. If the jury's view was that process engineers should always be available on-site, then that is an expectation that cannot be met. There are simply far more process plants in Australia than process engineers.

What is clear is that the jury considered that the danger should have been correctly assessed, and that the relevant discipline to ensure this happened is process engineering. The profession now has the responsibility to determine how to ensure the necessary expertise is available to plant operators as and when it is required.

The Esso case has generated powerful judicial verdicts with respect to the community's expectations on companies in providing and maintaining safe workplaces. The engineering profession and individual engineers have crucial, unavoidable roles to play in delivering industrial safety. The Longford tragedy underscores the responsibilities and challenges that continually face the profession.