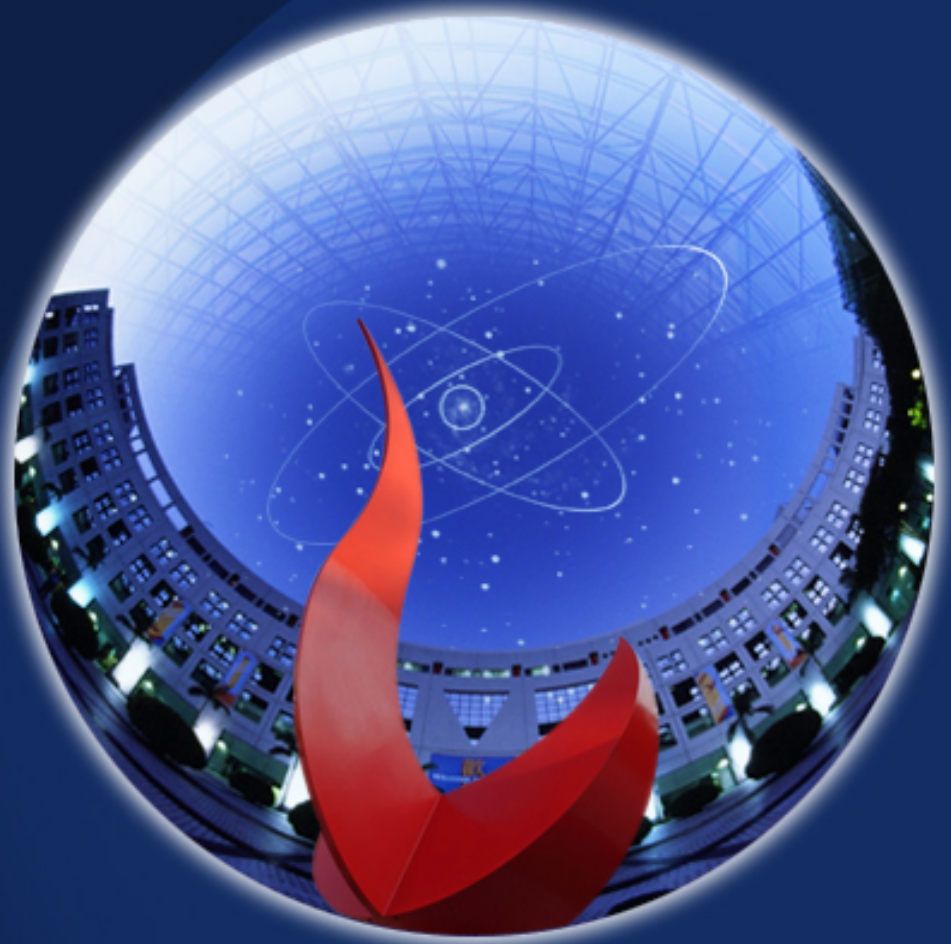

Teaching and Learning Symposium 2007

Development of HAZOP Study Teaching Module

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Structure of Presentation

- Aim of Project
- Development Phases
- What is a HAZOP Study
- Why develop a HAZOP Teaching Module
- Objectives and Outcomes
- Project Management
- Implementation Methodology
  - Phase 1 – Development of Teaching Module
  - Phase 2 – Extension of Teaching Module
  - Phase 3 – Adaptation to Incorporate New Case Study

Aim

- This project involved the development of an animated software teaching package to teach a process safety technique – HAZOP – to students

Development Phases

i. Phase 1 – Development of HAZOP Study Teaching Module (12 months)

ii. Phase 2 – Extension of the HAZOP Study Teaching Module (6 months)

iii. Phase 3 – Adaptation of the HAZOP Study Module to include New Case Studies (3 months)

- At each stage extensive testing and evaluation of the model was carried out and the feedback information was then incorporated into the next phase of development
- Evaluations were undertaken locally as well as Australia, France and U. K.

What Does HAZOP Mean?

- The term is short for HAZARDS and OPERABILITY study. It is an analysis method to identify and minimize the hazards of a process AND/OR improve the effectiveness/efficiency of the process.
- “Develops high quality technical expertise in safety engineering”

What is the Principle of a HAZOP Study?

- The Hazard and Operability (HAZOP) Analysis technique is based on the principle that several experts with different backgrounds form a team to interact in a creative, systematic fashion and identify more problems when working together than when working separately and combining their results

Why Develop a HAZOP Teaching Module?

- Challenges teaching HAZOP in the existing course
  - student difficulties in using all the information they have acquired and adapting to this qualitative assessment
  - somewhat heavy and dry theory within the HAZOP lectures
  - time-consuming study and final year students may miss some key sessions due to job hunting
  - the absence of an absolute answer to HAZOP, which results in difficulties and time for faculty in developing numerous alternatives
  - there is often no absolutely correct answer to a HAZOP – there are a number of potentially correct solutions as well as many incorrect ones (a concept that students often have difficulty with)

Project Objectives

1. Role play experience – Chairperson, Technical Secretary, etc.
2. Performing well in Meetings and Communications – two way, verbal, written
3. Working in a team
4. Multidisciplinary activity
5. Working in a real world “Design Office” environment
6. Systematic thinking, problem solving skills and analysis
7. Very wide-ranging knowledge base applications
8. Evaluation and reflection assessments for the HAZOP Teaching Module

Planned Outcomes

Major outcomes and deliverables (Phase 1):

1. Develop course materials
2. Develop animated HAZOP software package
3. Application testing of HAZOP module
4. Prepare and implement evaluation and usefulness Reports
5. Analysis of item 4 to assess effectiveness of enhanced teaching and learning

Project Management

- Development of Plan of Actions
- Development of Project Implementation
  - This Teaching Module was developed jointly by the teams from Chemical Engineering and CELT
  - It was therefore important that the two teams developed a detailed list of assigned tasks and schedule at the project planning stage

Project Timeline and Major Milestones (Phase 1)

Period	Milestones
Weeks 1 – 2	1. Detailed definition of scope of all project components (2 weeks) - **CENG**
Weeks 3 – 10	2. Development of course materials in note and presentation format – including HAZOP study method schematics (8 weeks) – **CENG**
Weeks 11 – 22	3. Interactive 2 or 3 demo case studies (12 weeks) – **CELT** – Flow Chart of HAZOP Study Method – Animated HAZOP Examples – HAZOP Study Minutes Sheet
Weeks 11 – 18	4. Develop Case Study Example - **CENG**: – Process Description [PD] (1 week). – Technical Specifications (3 weeks). – Process Flow Diagrams [PFD] (2 weeks). – Solution (2 weeks).

Implementation Methodology

Phase 1: To Develop a HAZOP Study Teaching Module

- This first phase was focused on the content and development of the HAZOP Safety Study module. What would make it different from a “stand – up, front of class” delivery and what should we introduce to make the student “want” to go on himself/herself.
- Coordinating, planning and exchanging ideas between the CENG team and the CELT team were important issues. Understanding the strengths and problems for each group was also important.

Implementation Methodology

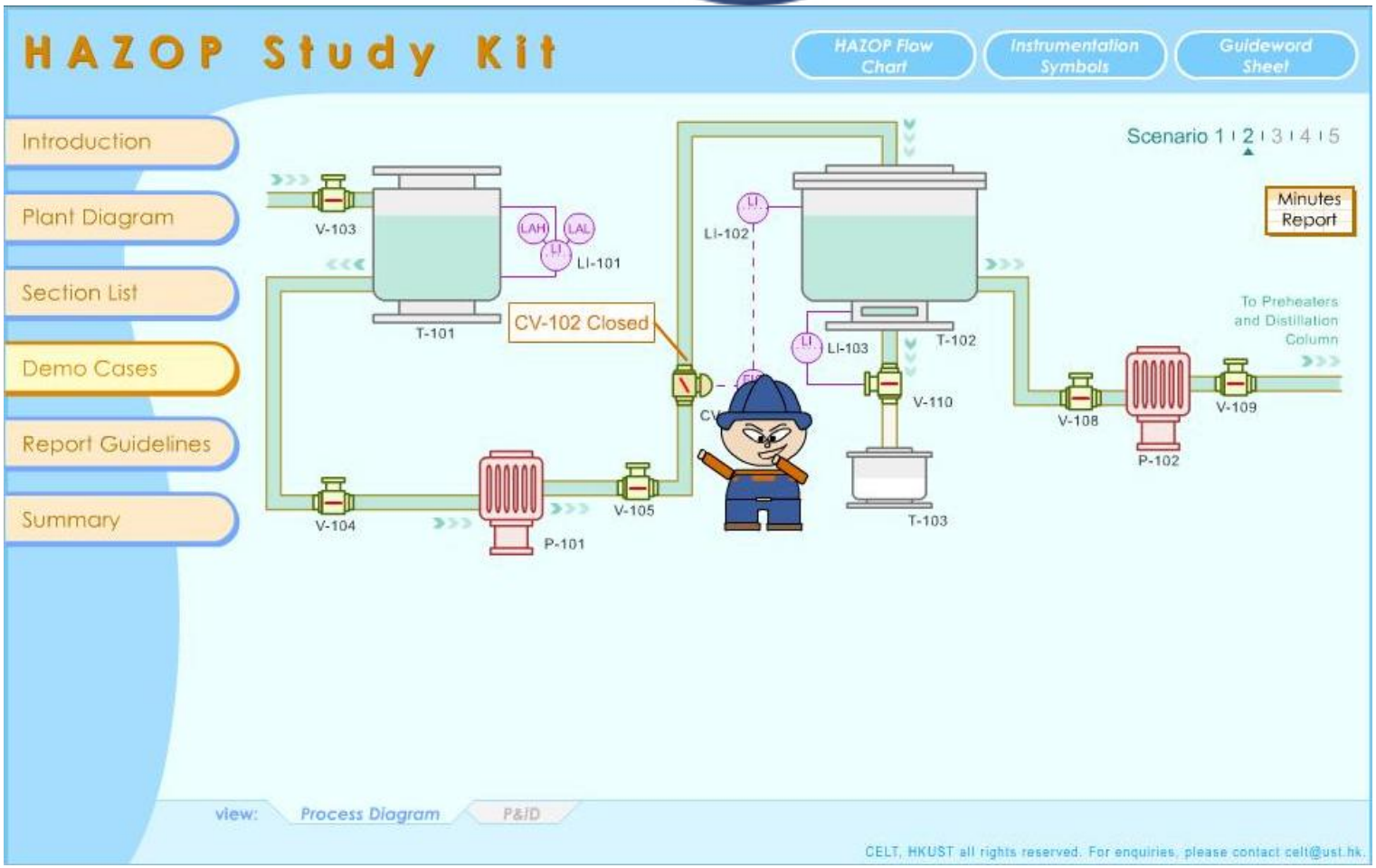
Phase 1: To Develop a HAZOP Study Teaching Module

- We decided to design the module based on
  1. a “good guy” versus “bad guy concept”
  2. a series of questions and answer prompts for the students to make a selection; for example:

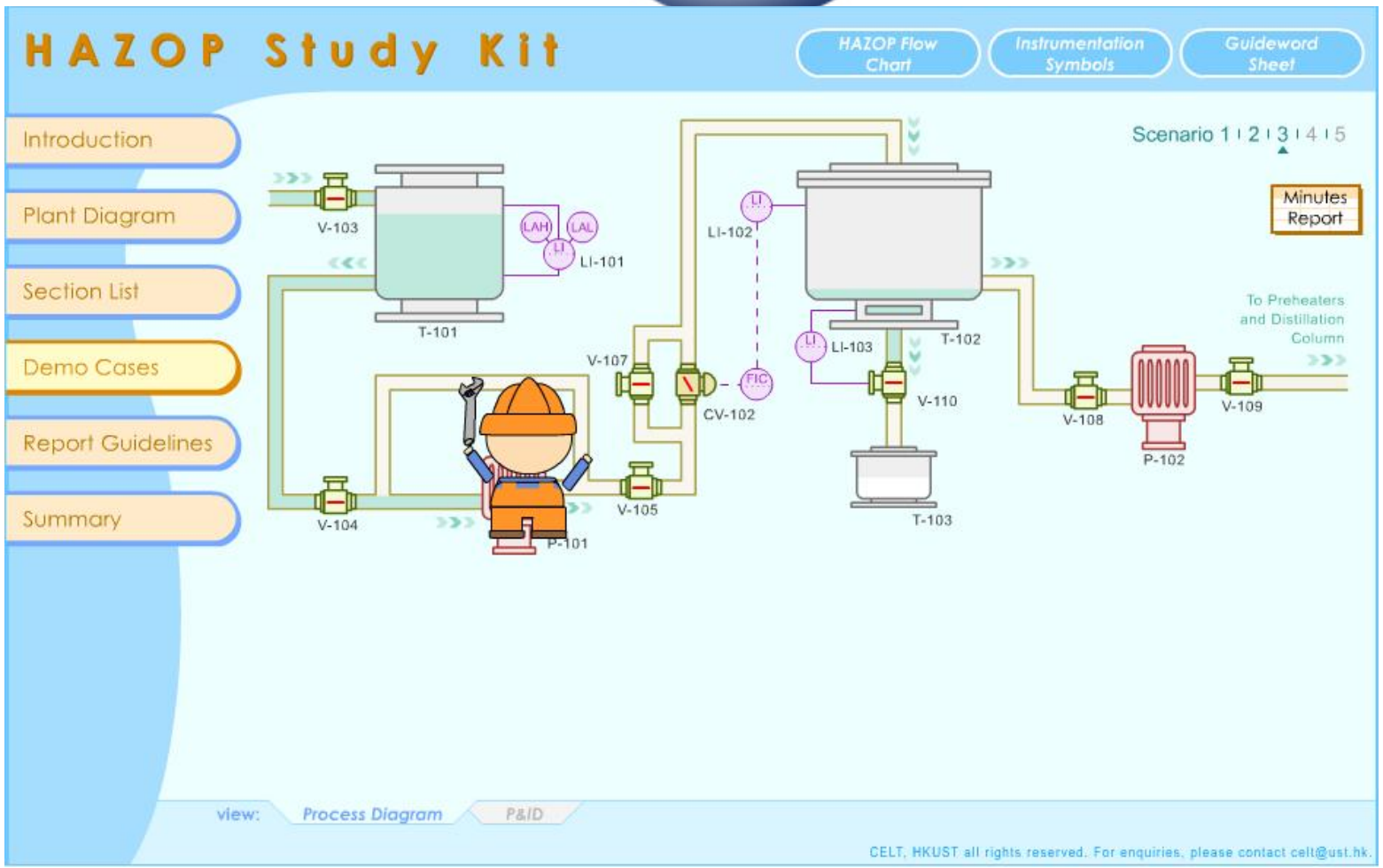
     What are the causes of NO FLOW in the pipeline?

     What are the consequences of a valve being closed?
  3. incorporate some humour

A Bad Guy in the HAZOP Study Teaching Module – Phase 1



A Good Guy in the HAZOP Study Teaching Module – Phase 1

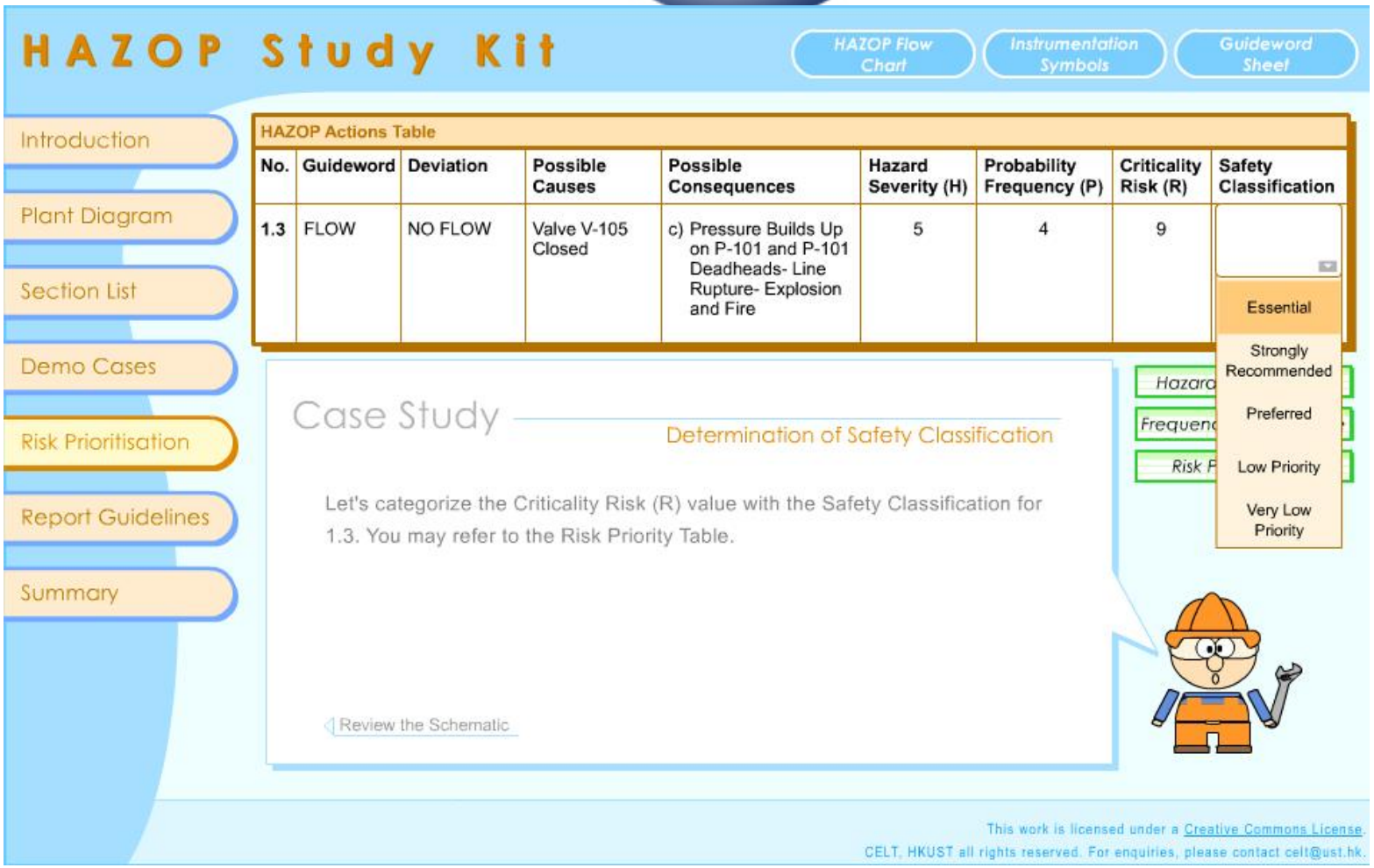


Implementation Methodology

Phase 2: Extension of HAZOP Study Animated Module to Incorporate Prioritisation of HAZOP Study Actions

- After completion of Phase 1 a number of evaluations were carried out and feed back was obtained from student users and at peer level from teachers and industrialists
- The results of the evaluations feedback resulted in our proposal for an extension award of the original project to incorporate a methodology for prioritizing the HAZOP Actions

Risk Prioritization of HAZOP Actions – Phase 2



Implementation Methodology

Phase 3: Adaptation of HAZOP Study Module to include New Case Studies

- The third phase of development of this teaching module began with a review of evaluations from both the first and second phases
- Only one comment occurred frequently and far outweighed any other issues. This was a request for other case studies in safety areas different from the ones currently in the module.

Evaluation Processes and Actions

- Several reviews/surveys were carried out to monitor the progress and also on the effectiveness of the module itself
- The procedures for reviewing were similar for each of the three phases
  1. Progress Review Meetings/Reports
  2. Collect Data to Assess the Effectiveness of Planned Actions and Outcomes
  3. Close Out Interviews

Progress Review Meetings/Reports

- On average the teams met once per month to review progress. This frequency decreased during long tasks
  - e.g. the development of the script by the chemical engineering department;
- and increased during the more interdependent activities
  - e.g. the development of the animated case studies jointly by both CELT and CENG

Collect Data to Assess the Effectiveness of Planned Actions and Outcomes

- CELT led the development of a range of comprehensive survey/questionnaire forms to assess the effectiveness of many aspects of the project, over a three year period including:
  1. Department of Chemical Engineering, HKUST
  2. Survey Questionnaire for Students to Complete
  3. Survey Questionnaire for Industrialists to Complete (6 industrialists)
  4. Survey Questionnaire for Peers to Complete (6 faculty)
  5. Feedback from HKIE Professional Accreditation

Collect Data to Assess the Effectiveness of Planned Actions and Outcomes

2. Survey Questionnaire for Students to Complete
   - Small student Group for initial appraisal (5-8 students)
   - Final Year Course Component in CENG303, HKUST (60 students)
   - Final Year Design Groups in Department of Chemical Engineering, University of Sydney (9 students)
   - Final Year Design Groups in Department of Chemical Engineering, Queen's University of Belfast, Ireland (12 students)
   - MSc in Project Management, Multi-Disciplinary, Ecoles des Mines de Nantes, France (12-18 students)

Feedback Actions

- For example, the small student group, who provided feedback on the first prototype model. The group comprised non-chemical engineering students, chemical engineering students who had not taken any HAZOP course and chemical engineering students who had completed the HAZOP course. The feedback was wide ranging and included comments on:

Feedback Actions

- visualization and colour
- user friendliness
  - making go back as well as forward
  - provide easier access to prompts
- accessing data sources
  - more apparent labeling
- comprehension
- technical feedback
  - more model scenarios
  - no quantitative data provided, could something be included
- These last two points led to the implementation of Phases 2 and 3 of the project

Close Out Interviews

- At the end of each Phase of the project a major close-out interview is held to assess the effectiveness of all aspects of the project, for example:
  - enhanced learning
  - quality of outcomes
  - teamwork between CELT and CENG

Conclusions

I simply state TWO points from the close out report:

1. At the end of the first phase, which was the major development phase of the project, there were several things that the chemical engineering team members were unaware of in terms of liaising and management and also from the CELT side. As the project developed in the first phase, we had a good team relationship and we solved the problems fairly quickly, then phases two and three were actually very smooth and carried out very effectively. So in the light of the last two phases, I think I can't think of anything that we could do better.

Conclusions

I simply state TWO points from the close out report:

2. The evaluations were provided by CELT, and were very comprehensive evaluations, that is where we got our information to develop stage two and stage three to actually incorporate the case study from the result of the evaluation. The first two phases we actually did four evaluations, with an even wider range of people, from my final year class, from an MSc class in France, we asked the chemical engineering department in Queen's University Belfast to do it, and in the chemical engineering department in University of Sydney, where we collaborated with them.

Conclusions

I simply state TWO points from the close out report:

(Continued)

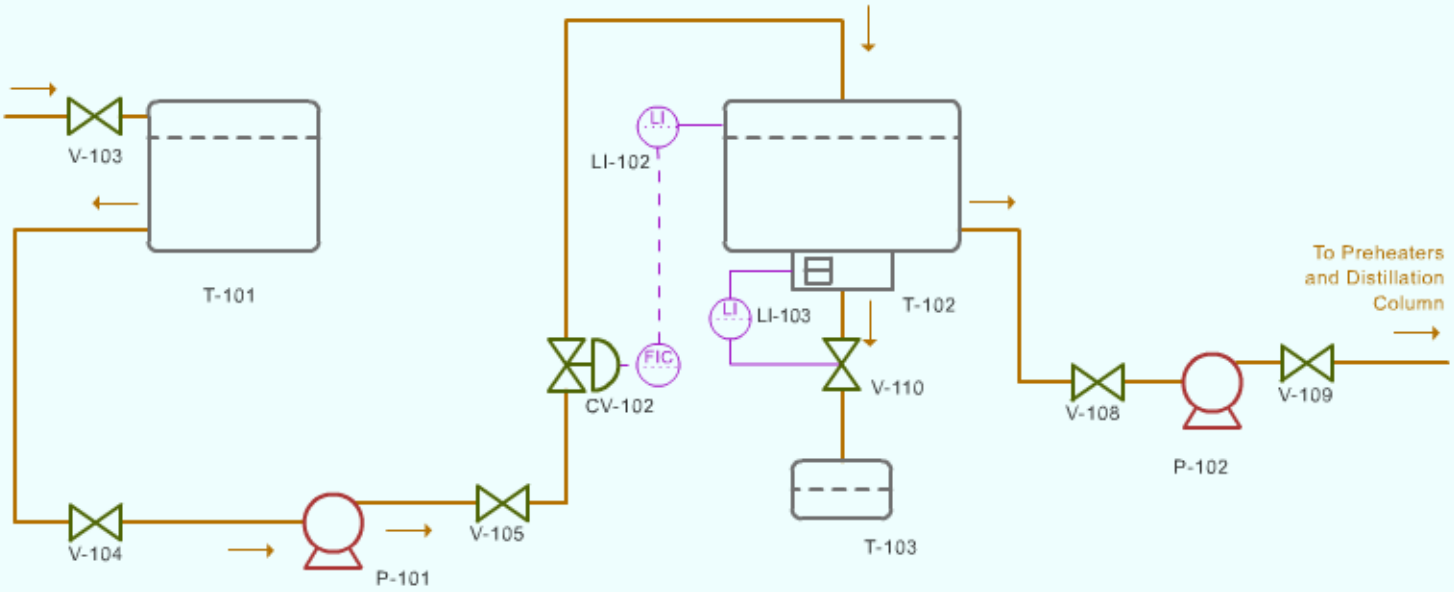
2. The first two phases had very intensive evaluations to get very wide feedback. The last phase, which is an addition of the case study, was actually then undertaken by the groups that I mentioned before. The last two evaluations are actually very very good.

P&ID Before HAZOP

HAZOP Study Kit

HAZOP Flow Chart | Instrumentation Symbols | Guideword Sheet

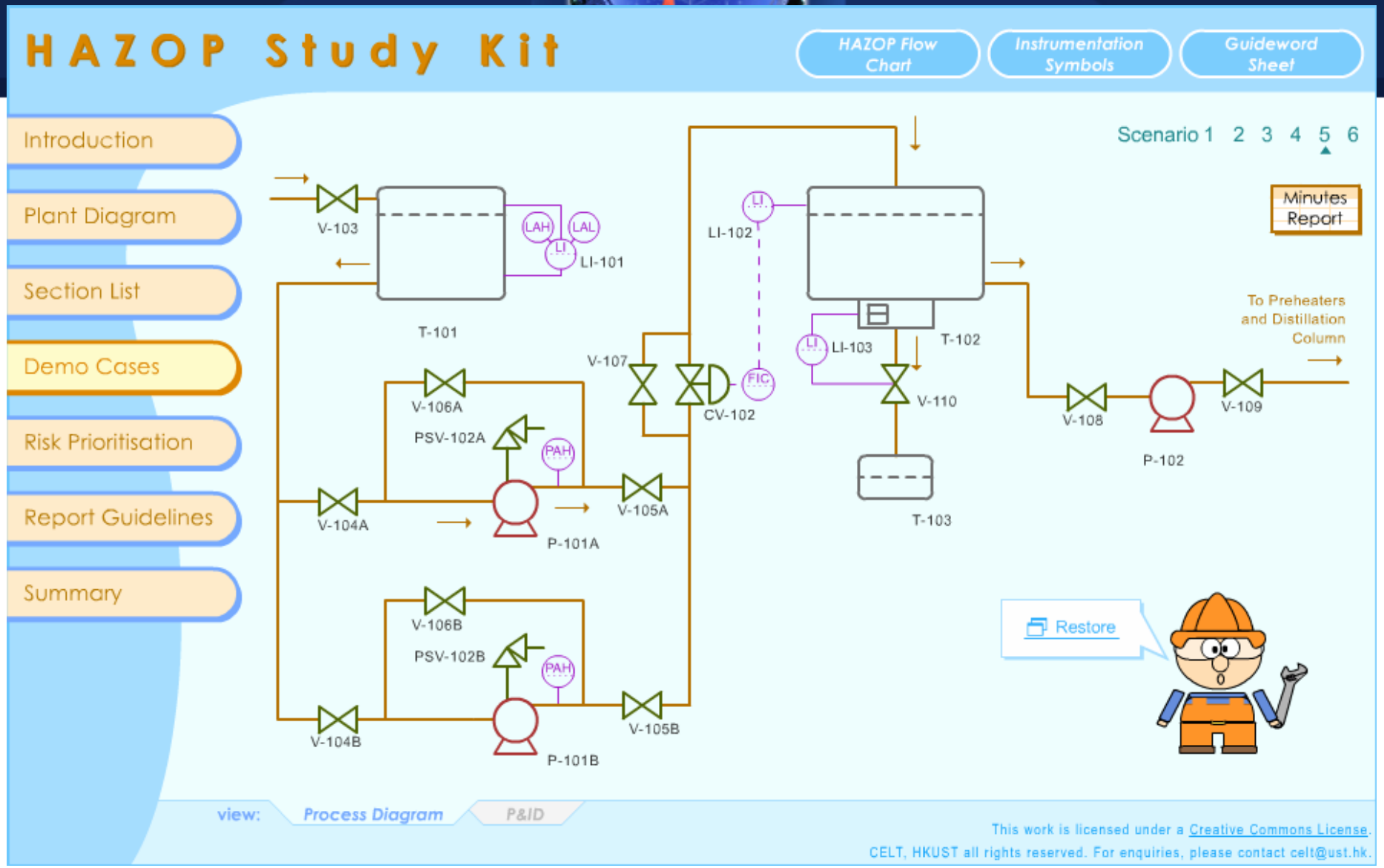
- Introduction
- Plant Diagram
- Section List
- Demo Cases
- Risk Prioritisation
- Report Guidelines
- Summary



Continue to description

view: Process Diagram | P&ID

P&ID After HAZOP



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