UNIVERSITY COLLEGE LONDON

University of London

EXAMINATION FOR INTERNAL STUDENTS

For The Following Qualification:-

Chemical Eng E876: Advanced Safety and Loss Prevention

COURSE CODE   :   **CENGE876**

UNIT VALUE   :   **0.50**

DATE   :   **27-MAY-03**

TIME   :   **10.00**

TIME ALLOWED   :   **3 Hours**

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Answer FOUR questions only with no more than TWO questions from each SECTION. Only the first FOUR answers will be marked.
ALL questions carry a total of 25 MARKS each, distributed as shown [ ]

SECTION A

1. i)   Define the key elements of successful health and safety
         management system.   [10]

    ii) The results from measuring performance measurements combined with
         information obtained from health and safety audits can be used to
         improve health and safety management. Describe ways in which
         effective audit programmes can benefit an organisation.
                                                                     [15]

2. Inherent safety is the best way of ensuring safety.

    i)   Identify the principal techniques of inherent safe design that
         are considered to limit hazards in a process plant.   [10]

    ii) Describe the main constraints relating to the development
         of inherently safer plants.   [15]

3. i)   What are the two main classification groups of devices that can
         be used to provide pressure relief, and give one example of each?   [4]

    ii) What are the advantages and disadvantages of using bursting
         discs?   [9]

    iii) Figure 1 shows a vessel V-01 operating at 20 barg and 25°C.
         The vessel design pressure is 29 barg and has a relief valve
         PSV-001 protecting the vessel V-01 against overpressure.
         Identify credible scenarios which should be considered to
         determine the minimum orifice size of the relief valve required.   [12]
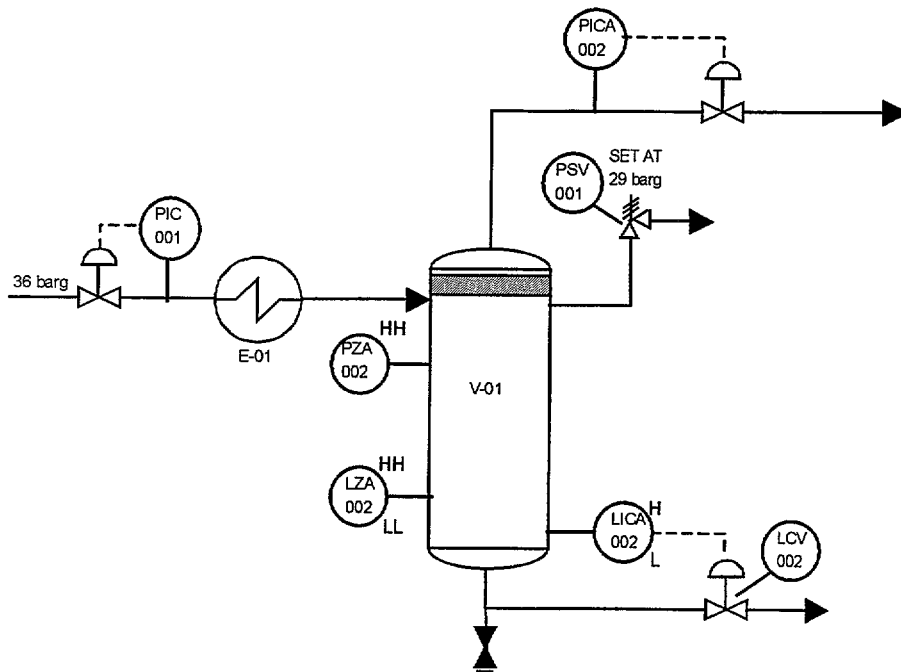
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Figure 1. Process and instrumentation flow diagram for a pressurised vessel

SECTION B

4. Explain (i) what quantitative risk assessment (QRA) is, and (ii) how you would use it. [25]

5. i)   In evaluating explosion hazards what are

    (a) the factors controlling the magnitude of the event [6]

    (b) it's principal effects [3]

    Explain how these effects can be mitigated. [3]

    ii) Compare and contrast the usual extremes of hydrocarbon fire giving

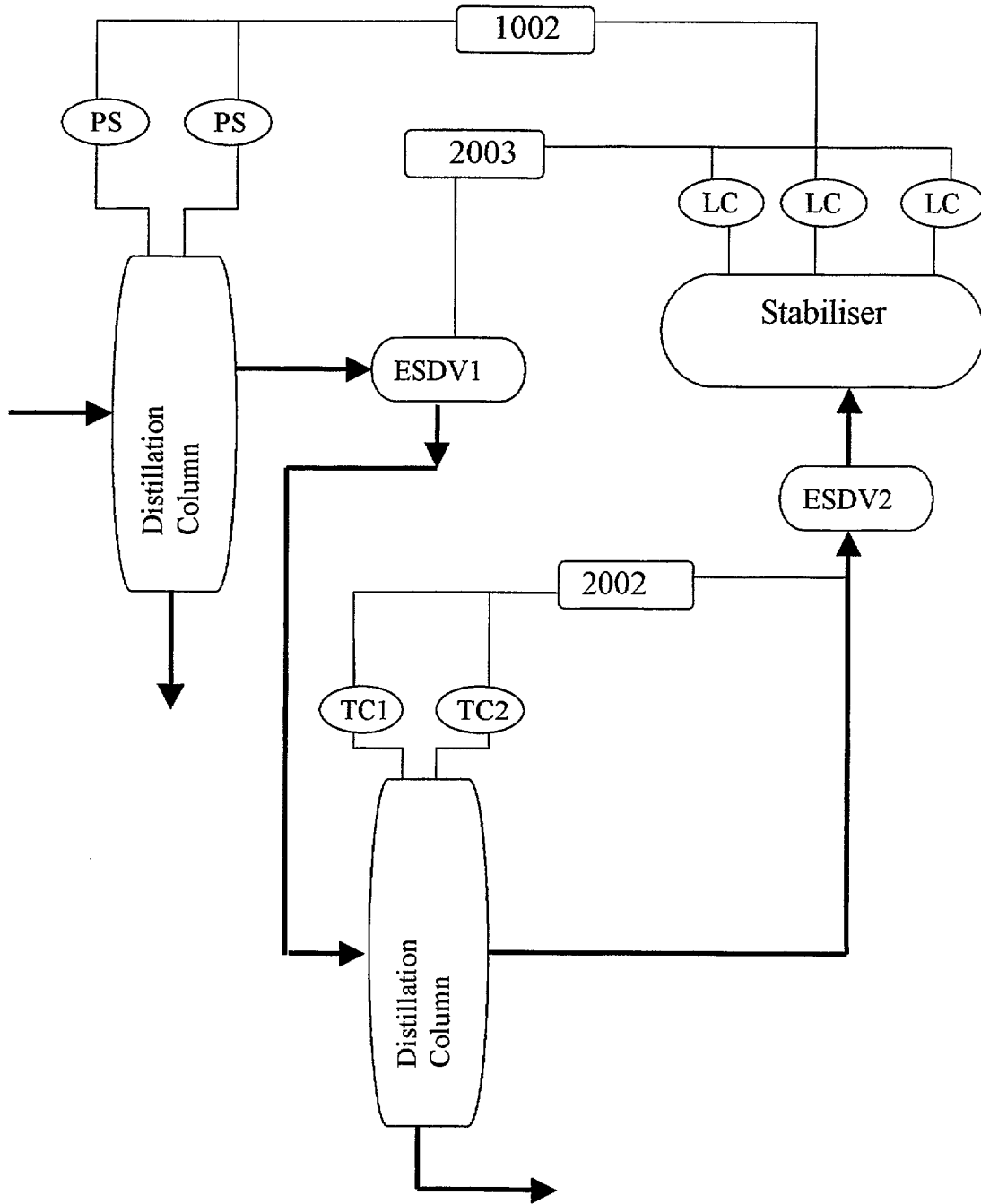   (a) their essential characteristics [7]

    (b) their principal effects [6]

    PLEASE TURN OVER

6. Explain what is meant by the term 'Availability' in the context of process safety by expressing it in terms of a simple algebraic equation carefully explaining the symbols used. [5]

i) Write down an expression for the total availability, A_T of a system comprising 'n' components of equal availability, A in terms of a Binomial expansion series incorporating the first 4 terms. [4]

ii) Figure 2 shows a process and instrumentation flow diagram for a purification plant. Draw the corresponding availability block diagram and calculate the total process availability given the following component availabilities. [16]

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	Availability
Pressure switch (PS)	0.9926
Level switch (LS)	0.9862
Emergency shutdown valve 1 (ESDV1)	0.9824
Temperature controller 1 (TC1)	0.9876
Temperature controller 2 (TC2)	0.9524
Emergency shutdown valve 1 (ESDV1)	0.9867

1002

PS   PS

2003

LC   LC   LC

Stabiliser

ESDV1

Distillation Column

ESDV2

2002

TC1   TC2

Distillation Column

END OF PAPER