Name: _____ Student ID _____

Prince of Songkla University
Faculty of Engineering

Exam: Mid-Term, Semester I **Academic Year: 2011 – 2012**
Date: August 7, 2011 **Time: 1:30 – 4:30 PM**
Subject: 230-334 – Safety **Room: S201**
(Safety in Chemical Engineering Operations)

ทุจริตในการสอบโทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา

CLOSED BOOK EXAM: No notes and no sheets are allowed.

Points Distribution (For Grader Only)		
Part	Points Value	Score
I	40	
II	35	
III	30	
IV	30	
V	35	
VI	30	
Total	200	

Exam prepared by
Ram Yamsaengsung
July 31, 2011

PLEASE CHECK TO MAKE SURE THAT
YOU HAVE ALL 13 PAGES OF THE EXAM BEFORE BEGINNING
(not including the cover sheet and attachment).
GOOD LUCK!

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I. FILL IN THE BLANKS (40 points)

1. Three methods of treating effluents leaving the factory are using an absorber, a _____ or a _____.
2. To produce a fire, it is necessary to have _____, _____, and _____. This is also known as _____.
3. In a well design facility, the equipment should only take up about _____ % of the entire floor space.
4. An inflammation of the skin that causes an allergic reaction is called _____.
5. The _____ maintains proper keeping of all documents, calculations, reports, procedures and operational logs.
6. For high pressure equipment, the safety devices that must be installed include _____, _____, and _____.
7. If organic solvents are used for cleaning equipment, the work (cleaning) should be done in a _____.
8. The _____ appoints the laboratory safety officer and is usually the head of the department.
9. The _____ acts as a liaison with the site safety officer, inspectors of the Health and Safety Executive, and insurance inspectors.
10. _____ are highly toxic by ingestion and are rapidly absorbed by the skin producing intensive burns.
11. Bulk storage of toxic or flammable liquids in excess of _____ is not recommended on site.
12. The _____ acts as the secretary of the laboratory safety committee.
13. A signature on behalf of the _____ must be present on the safety policy.
14. The _____ area and the _____ area are in charge of ordering and purchasing.
15. The _____ maintains scheduled and recorded inspection, examination, repair and replacement according to statutory, organization, and insurance requirements.
16. The preferred method of stacking drums in the open air is to stack them _____.

17. LPG is an abbreviation for _____ and must be stored in properly designed vessels, in which at least _____ unfilled space must be allowed to prevent the development of dangerous pressure.
18. Steel supports should give a fire resistance of _____ hours.
19. Two types of human indiscipline that could cause hazards include _____ and _____.
20. The _____ acts as the chairperson of the laboratory safety committee.
21. For vibration and noise, damage occurs at about _____, for a short period of exposure and _____ for continuous noise.
22. The sudden release of vacuum is called _____.
23. Metal containers should have about ____ % extra space to allow for liquid expansion.
24. The storage of bulk amount of toxic and chemical liquids is preferably stored in _____.
25. The _____ should arrange for an inspection of the equipment and factory every ____ months.
26. Quantities of flammable liquid more than _____ should be kept in outside stores.
27. The _____ ensures that equipment used in work under their direction is of safe design and construction.
28. For transporting or transferring gas tanks within the lab, a _____ should be used. If a large quantity like large cases (big boxes) must be moved, a _____ or a crane may be used.

II. SHORT ANSWERS (35 points)

1. Name 5 things that must be included in a general safety policy. **(5 points)**

2. Name 4 major dangers from electrical hazards. **(4 points)**

3. With long term exposure to toxic hazards, what are the damages that may be caused to the body? **(2 points)**

4. List 6 Protective Personal Equipment that must be worn when working in an industrial site, chemical facility, chemical laboratory, or a metal shop. **(6 points)**

5. Discuss the major steps in a design of a laboratory. What questions must be considered? Why should a lab be modernized? What is a typical option in which modernization can be implemented? **(8 points)**

6. From your answers in Problem 5, draw a layout (floor plan) of a restaurant that you plan to open using the area the size of room S104. Make sure to list of the facilities, equipment, emergency concerns, etc. **(10 points)**

III. CSB VIDEO (30 points)

1. Match the following information with the safety video that it was from? **(16 points)**

(a) Union Carbide, Bhopal
(b) Cyntron Manufacturer (Acrylic Polymer)
(c) BP Amoco Polymer Plant (High Performance Nylon)
(d) MFP Chemical Plant (plastic additives, Tri-allo, cyanurate - TAC)
(e) Explosion at BP Refinery, Texas City
(f) Death in the Oil Field

____ **1. Maintenance workers were killed when they tried to clean out plastics from a waste tank.**
____ **2. A lid acetylene torch was inserted into a storage tank to test for the presence of hydrocarbons.**
____ **3. Liquid reached a height of 98 ft before noon and overflowed around 1 pm into the relief line and up a blow-down drum.**
____ **4. Highly toxic gas was released due to improper scale-up of process.**
____ **5. Inadequate instructions and communications between operators of day and night shifts led to the accident.**
____ **6. A toxic chemical release from a pesticide plant killed thousands of people.**
____ **7. The overhead heat exchanger could not handle the amount of heat produced by the production process.**
____ **8. A 12% increase in production caused a runaway reaction leading to the release of toxic vapor clouds and a violent explosion.**
____ **9. Control Board Operators worked for 30 straight days at 12 hours shift.**
____ **10. Three maintenance workers were killed during a welding operation.**
____ **11. Slow decomposition took place releasing large amount of gas and increasing the internal pressure inside of a waste storage tank.**
____ **12. This accident in India led to the establishment of the Chemical Safety Board.**
____ **13. Budget cuts impacted the process safety system leaving 2 operators to oversee major units.**
____ **14. The heat jacket could not handle the amount of heat produced by the production process.**
____ **15. A ladder was used as a platform during "Hot Work" operation.**
____ **16. The level indicator of isomerization unit gave incorrect values, several alarms failed and tower overflowed.**

2. From the BP Refinery Texas City Accident, discuss the causes that led to the accident, how much damage resulted, and how the accident could have been prevented, including suggestions from the Chemical and Safety Hazards Investigation Board (CSB). **(14 points)**

IV. INDUSTRIAL ACCIDENTS (30 points)

Read the following articles below and answer the following questions? **(30 points)**

1. **Article 1: (12 Points)**

Overfilling Tanks – What Happened?

September 2006

Photograph courtesy of Royal Chiltern Air Support Unit

On Sunday December 11, 2005, gasoline (petrol) was being pumped into a storage tank at the Buncefield Oil Storage Depot in Hertfordshire, England. At about 1:30 AM a stock check of the tanks showed nothing abnormal. From about 3 AM, the level gauge in one of the tanks recorded no change in reading, even though flow was continuing at a rate of about 550 cu. meters/hour (2400 US gallons/minute). Calculations show that the tank would have been full at about 5:20 AM, and that it would then overflow. Pumping continued and the excess gasoline overflowed from the top of the tank and cascaded down the sides, forming a liquid pool and a cloud of flammable gasoline vapor. At about 6:00 AM the cloud ignited and the first explosion occurred, followed by additional explosions and a fire which engulfed 20 storage tanks. Fortunately there were no fatalities, but 43 people were injured. 2000 people were evacuated, there was significant damage to property in the area, and a major highway was closed. The fires burned for several days, destroying most of the site and releasing large clouds of black smoke which impacted the environment over a large area.

3.1 What caused the accident? (2 points)

3.2 When and what type of explosion took place? How long did the fire last? (3 points)

3.3 What were the consequences from the accident? (4 points)

3.4 What should have been done to prevent the accident? (3 points)

Article 2: (8 Points)

Japan nuclear plant 'safe' by January

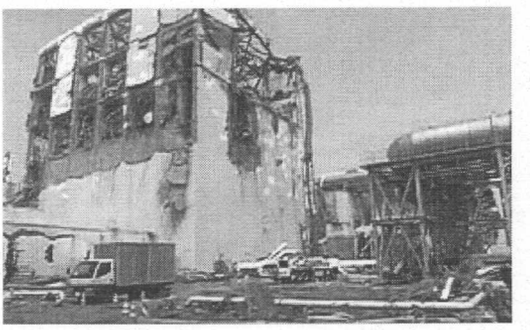


PHOTO Water is sprayed onto the spent fuel pool of Unit 4 at the Fukushima Daiichi Nuclear Power Station in March. [TEPCO]

Last Updated: Wed, 20 Jul 2011 10:16:00 +1000

Efforts to stabilise the worst nuclear crisis since Chernobyl 25 years ago have continued since a 9.0 magnitude earthquake triggered a tsunami on March 11, sparking reactor meltdowns at the plant and spewing radiation into the environment.

Challenges ahead

The government said radiation levels around the plant, which lies 220 kilometres (136 miles) from Tokyo, had fallen to "two-millionth" of the peak recorded March 15. Tens of thousands of people remain evacuated from homes, businesses and farms in a 20 kilometre no-go zone around the plant. Amid criticism it has done little to safeguard local residents from radiation risks, the government pledged to earmark 78.2 billion yen ($US990 million) for a health program to monitor radiation exposure of all Fukushima residents.

Renewed food safety worries have emerged after contaminated beef was found to have been shipped around the country and probably eaten, prompting Japan to announce a ban on Fukushima beef cattle shipments.

3.5 What caused the nuclear meltdown and when did it occur? (2 points)

3.6 When and where was the last major nuclear meltdown (crisis)? (2 points)

3.7 What is the current radiation level? How far is this nuclear reactor from Tokyo (2 points)

3.8 What is the name of thid nuclear power point? What is the new food safety concern? (2 points)

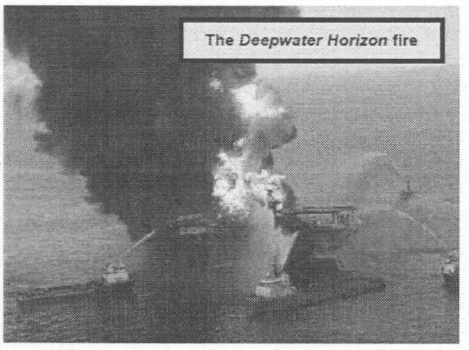
Article 3: (10 Points)

Shows Oil Stopped

ABC NEWS

BP Says Oil Stops Leaking in Test for First Time in 87 Days

For the first time in 87 days, oil has stopped flowing into the Gulf of Mexico from BP's broken well. In a test, BP's new containment cap successfully contained the leak starting at 3:25 p.m. ET today, BP confirmed at an afternoon press conference. Live video of the leak showed no oil at the site where plumes of oil had been seen billowing into the Gulf since the disaster began on April 20th.



At the White House, President Obama reacted to the news, saying, "I think it's a positive sign. We're still in the testing phase, I'll have more to say on it tomorrow."

Louisiana Gov. Bobby Jindal, a Republican, issued a statement expressing cautious optimism.

"It is too early to declare victory...." Jindal said. "Our battles don't end even when the well is capped. Millions of gallons of oil are still in the Gulf and some estimates show that oil will continue to hit our shores for many more months or maybe even longer."

BP is now conducting step-by-stop tests of the massive, 150,000 pound cap on the wellhead, a process the company said could take up to 48 hours. The company said it is fully possible that oil will escape again before the testing is done.

Engineers slowly ratcheted down the flow of oil this morning and afternoon, closing off three valves -- cutting the so-called kill line at 11:30 a.m. and then closing the choke line at 1:30 p.m., BP executive Kent Wells wrote on the company Twitter account.

3.1 Where did the oil spill take place and which company is responsible? When did it begin? **(2 points)**

3.2 How was the spill stopped? How many days had the spill lasted? How much oil is still floating the Gulf? **(3 points)**

3.3 List 5 negative impact (consequences/losses) from this accident. **(5 points)**

V. FIRE PREVENTION TRAINING (35 points)

1. Name 4 basic ways to prevent a fire in home and office. **(4 points)**

2. Name 4 ways of extinguishing a fire. **(4 points)**

3. Name 5 common causes of fire. **(5 points)**

4. Name 5 ways of preparation for fire. **(5 points)**

5. When trying to put out a fire, list 3 circumstances (situations) in which you should run from a fire? **(3 points)**

6. Before you escape from a fire, what 4 things must you do or thinking about? **(4 points)**

7. From the Fire Training hosted by the Hat Yai Fire Department, discuss ALL the different scenarios presented and ways of handling them (for example: gas tank leak with and without regulator). Make sure you mention all the **training techniques** that you were taught. **(10 points)**

VI. DISCUSSIONS (30 points)

1. Using the attached diagram of a typical R&D facility layout (Fig.1), write where the following should be located: the service vehicles, the parking space for the employees and visitors, the office area, the workshops, store area, low hazards materials, high hazards materials, laboratory, control equipment, high hazard experimental area, and restricted area. (**10 points**)

2. Name 10 types of hazards that are found in our Chemical Engineering Department. Give specific examples of each (i.e. the slippery, greasy floor of the vacuum frying unit is a hazard). An example cannot be used more than once. Also give one way to prevent each hazard from occurring. **(20 points)**

BONUS: (10 Points)

1. What is N'Brave's favorite Transformer character? (2 points)

(a) Optimus Prime
(b) Bumblebee
(c) Iron Hide
(d) Sam

2. Where is N'Bright going to school now? (2 points)

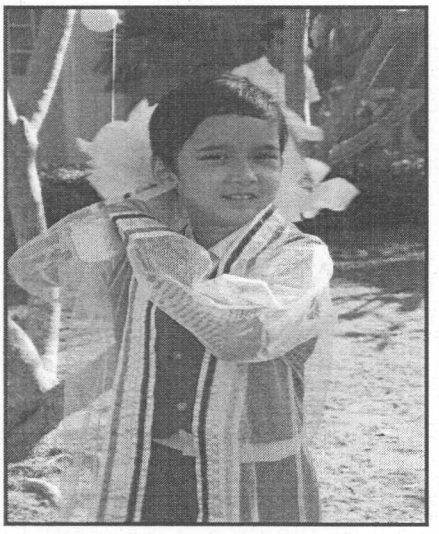
(a) Na School (Anubarn Nakorn Hat Yai)
(b) Worapat School
(c) Saengthong Vittaya School
(d) Boonlert School

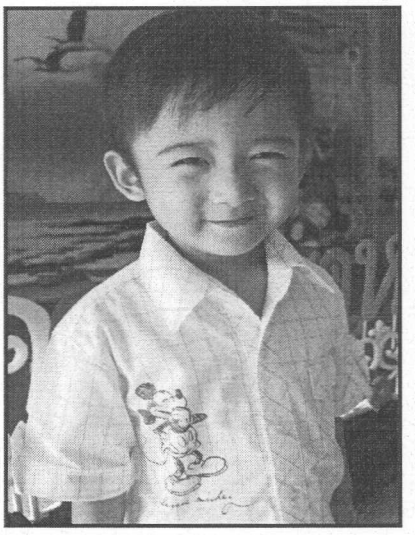
3. What is N'Bright's favorite restaurant? (3 points)

(a) Fuji
(b) KFC
(c) Pizza Company
(d) Hachiban

4. How much water/water vapor pressure is required to put out the following type of fire? (3 points)

(a) Electrical/electricity fire –
(b) Metals/chemicals fire –





CONGRATULATIONS! END OF EXAM!

Designing R&D Facilities

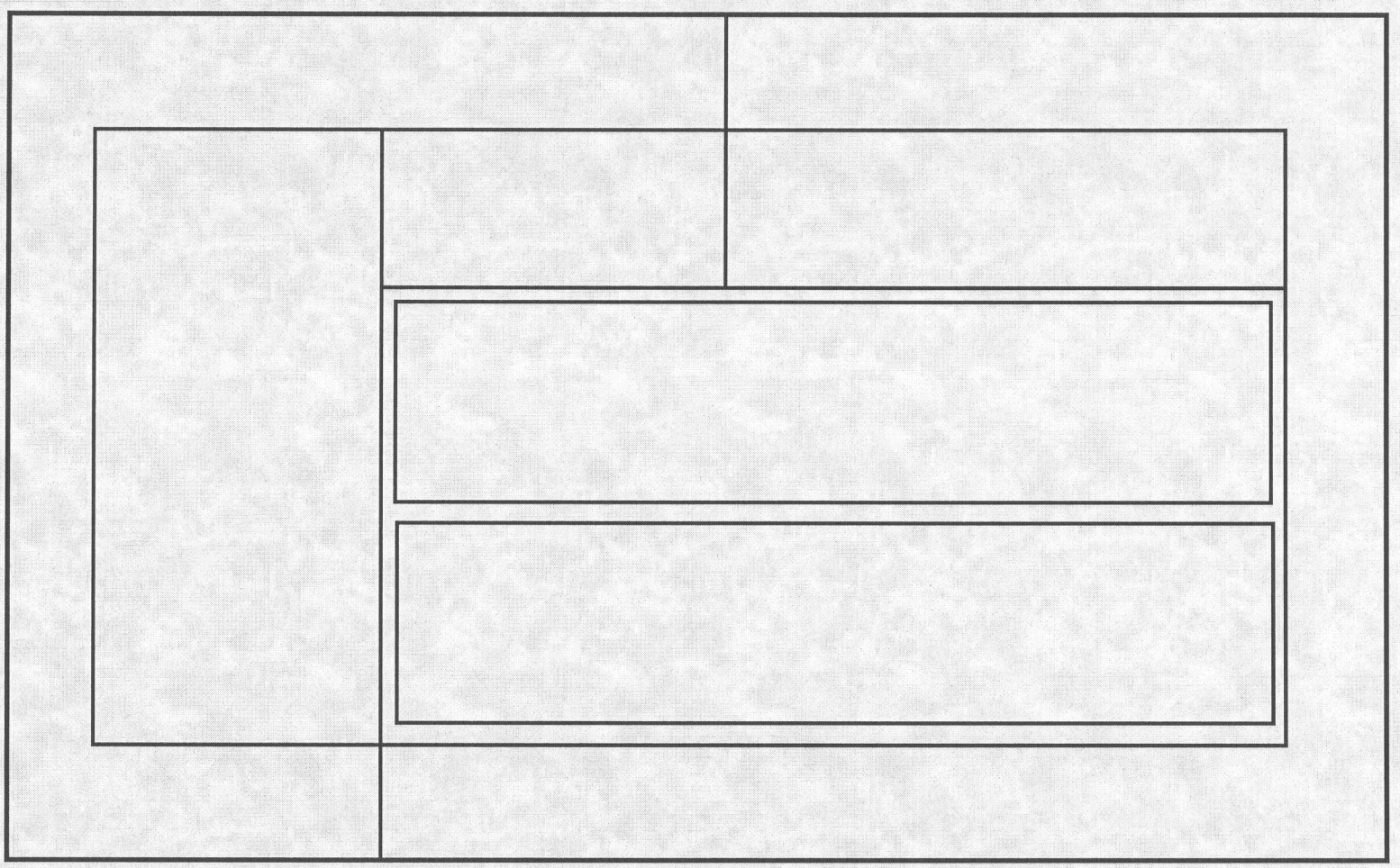


Fig. 1: Typical R&D facility layout