LAMPIRAN 1

WORKBOOK UNTUK ANALISIS KUALITATIF RBI [6]

Part A. Determination of Likelihood Category

Equipment Factor (EF) The size of the study will affect the probability of failure of a component in the study. The qualitative risk analysis is intended for use at three different levels: 1. Unit—A full operating unit at a site is evaluated. This would typically be done to compare and prioritize operating units based on risk of operation. 2. Section of an operating unit—an operating unit can be broken into logical (functional) sections to identify the high risk section of the unit. 3. A system or unit operation—this is the greatest level of detail that the qualitative method is intended to address.		
To define the Equipment Factor, use the following table: If a full operating unit is being evaluated, (typically greater than 150 major equipment items) EF = 15 If a major section of an operating unit is being evaluated, (typically 20–150 major equipment items) EF = 5 If a system or unit operation is being evaluated (typically 5–20 major equipment items) EF = 0 Select the appropriate value for EF from above.		
This is the overall Equipment Factor	1	

Part A. Determination of Likelihood Category

Damage Factor (DF) The damage factor is a measure of the risk associated with known damage mechanisms that are active or potentially active in the operation being evaluated. The mechanisms are prioritized based on their potential to create a serious event.		
If there are known, active damage mechanisms that can cause corrosion cracking in carbon or low alloy steels, DF1 = 5.	2	
If there is a potential for catastrophic brittle failure, including carbon steel materials due to low temperature operation or upset conditions, temper embrittlement, or materials not adequately qualified by impact testing, DF2 = 4.	3	
If there are places in the unit where mechanically thermally-induced fatigue failure has occurred and the fatigue mechanism might still be active, DF3 = 4.	4	
If there is known high temperature Hydrogen attack occurring, DF4 = 3.	5	
If there is known corrosion cracking of austenitic stainless steels occurring as a result of the process, DF5 = 3.	6	
If localized corrosion is occurring, DF6 = 3.	7	
If general corrosion is occurring, DF7 = 2.	8	
If creep damage is known to be occurring in high temperature processes, including furnaces and heaters, DF8 = 1.	9	
If materials degradation is known to be occurring, with such mechanisms as sigma phase formation, carburization, spheroidization, etc., DF9 = 1.	10	
If other active damage mechanisms have been identified, DF10 = 1.	11	
If the potential damage mechanisms in the operating unit have not been evaluated and are not being periodically reviewed by a qualified materials engineer, DF11 = 10.	12	
The overall Damage Factor will be the sum of lines 2 through 12, up to a maximum of 20	13	

Part A. Determination of Likelihood Category

Inspection Factor (IF) The Inspection Factor is a measure of the effectiveness of the inspection program to identify the active or anticipated damage mechanisms in the unit.		
Step 1. Vessel Inspection—Gage the effectiveness of the vessel inspection program to find the identified failure mechanisms above. • If the inspection program is extensive and a variety of inspection methods and monitoring are being used, IF1 = –5. • If there is a formal inspection program in place and some inspections are being done, but primarily visual and UT thickness readings, IF1 = –2. • If there is no formal inspection program in place, IF1 = 0.		
Select appropriate IF1 from above.	14	
Step 2. Piping Inspection—Gage the effectiveness of the piping inspection program to find the identified failure mechanisms above. • If the inspection program is extensive, and a variety of inspection methods are being used, IF2 = –5. • If there is a formal inspection program in place and some inspections are being done, but primarily visual and UT thickness readings, IF2 = –2. • If there is no formal inspection program in place, IF2 = 0.		
Select the appropriate value for IF2 from above	15	
Step 3. Overall Inspection Program—How comprehensive is the inspection program design, and are the inspection results evaluated and used to modify the inspection program? • If deterioration mechanisms have been identified for each equipment item and the inspection program is modified based on the results of the program using a competent inspector or materials engineer, IF3 = –5. • If the inspection program design excludes either identification of failure mechanisms or does not include critical evaluation of all inspection results, i.e., it does one or the other, but not both, IF3 = –2. • If the inspection program meets neither of the criteria of the previous paragraph, IF3 = 0.		
Select the appropriate value for IF3 from the table above.	16	
The overall Inspection Factor is the sum of lines 14 through 16, but its absolute value cannot exceed the value of the Damage Factor (line 13).	17	

Part A. Determination Of Likelihood Category

Condition Factor (CCF) The Condition Factor is intended to gage the effectiveness of plant maintenance and housekeeping efforts.		
Step 1. In a plant walkthrough, how would the plant housekeeping be judged (including painting and insulation maintenance programs)? • Significantly better than industry standards, CCF1 = 0. • About industry standard, CCF1 = 2. • Significantly below industry standards, CCF1 = 5.		
Select the appropriate value for CCF1 from above	18	
Step 2. The quality of plant design and construction is: • Significantly better than industry standards, where the owner has used more rigorous standards, CCF2 = 0. • About industry standard, where typical contract standards were used, CCF2 = 2. • Significantly below industry standards, CCF2 = 5.		
Select the appropriate value for CCF2 from above	19	
Step 3. In a review of the effectiveness of the plant maintenance program, including fabrication, PM programs, and QA/QC, they would be judged: • Significantly better than industry standards, CCF3 = 0. • About industry standard, CCF3 = 2. • Significantly below industry standards, CCF3 = 5.		
Select the appropriate value for CCF3.	20	
The overall Condition Factor is the sum of 18 through 20.	21	

Part A. Determination of Likelihood Category

Process Factor (PF) The Process Factor is a measure of the potential for abnormal operations or upset conditions to result in initiating events that could lead to a loss of containment.		
Step 1. The number of planned or unplanned process interruptions in an average year. (This is intended for normal continuous process operations.) PF1 is taken from the following table: Number of Interruptions — PF1 0 to 1 — 0 2 to 4 — 1 5 to 8 — 3 9 to 12 — 4 more than 12 — 5		
Determine appropriate PF1 from above.	22	
Step 2. Assess the potential for exceeding key process variables in the operation being evaluated: (PF2). • If the process is extremely stable, and no combination of upset conditions is known to exist that could cause a runaway reaction or other unsafe conditions, PF2 is 0. • Only very unusual circumstances could cause upset conditions to escalate into an unsafe situation, PF2 is 1. • If upset conditions are known to exist that can result in accelerated equipment damage or other unsafe conditions, PF2 is 3. • If the possibility of loss of control is inherent in the process, PF2 is 5.		
Select the appropriate value for PF2 from the table above	23	
Step 3. Assess the potential for protection devices, such as relief devices and critical sensing elements, to be rendered inoperative as a result of plugging or fouling of the process fluid. • Clean service, no plugging potential PF3 = 0. • Slight fouling or plugging potential PF3 = 1. • Significant fouling or plugging potential PF3 = 3. • Protective devices have been found impaired in service PF3 = 5.		
Select the appropriate value for PF3.	24	
The overall Process Factor is the sum of lines 22 through 24.	25	

Part A. Determination of Likelihood Category

Mechanical Design Factor (MDF) The Mechanical Design Factor gages certain aspects of the design of the operating equipment.		
Step 1. • If equipment can be identified that was not designed to the intent of current codes or standards, MDF1 = 5. Examples: nonimpact tested carbon steel in low temperature service, materials in hydrogen service operating above the latest Nelson curve, nonstress relieved materials in a particular service (such as caustic), or plate thicknesses that would require stress relieving by current code or good practices. • If all equipment being considered is designed and maintained to the Codes in effect at the time it was constructed, MDF1 = 2. • If all equipment being considered is designed and maintained to current codes, MDF1 = 0.		
Enter the appropriate value from the statements above. This is MDF1.	26	
Step 2. • If the process being evaluated is unusual or unique or any of the process design conditions are extreme, MDF2 = 5. Extreme Design Conditions are considered to be: a. Pressure exceeding 10,000 psi. b. Temperature exceeding 1500 °F. c. Corrosive conditions requiring high alloy materials (more exotic than 316 stainless steel). • If the process is common, with normal design conditions, MDF2 = 0.		
Select the appropriate value from the table above. This is MDF2.	27	
Step 3. Add lines 26 and 27. This is the Mechanical Design Factor.	28	

Part A. Determination of Likelihood Category

Likelihood Category		
Step 1. Determine the Likelihood Factor. The Likelihood Factor is the sum of the previously determined factors.		
Add lines 1, 13, 17, 21, 25, and 28. This is the Likelihood Factor.	29	
Step 2. The Likelihood Category is determined from the Likelihood Factor (line 29 above) using the following table: Likelihood Factor — Likelihood Category 0–15 — 1 16–25 — 2 26–35 — 3 36–50 — 4 51–75 — 5		
Enter the Likelihood Category.	30	

Part B. Determination of Damage Consequence Category

This section is to be used for flammable materials, if only toxic chemicals are present, go directly to Part C.

Chemical Factor (CF)

The Chemical Factor is a measure of a chemical's inherent tendency to ignite. The answers to this section should be based on the predominate or representative material in the stream. Separate analyses should be performed if the unit has a number of different process streams.

Step 1. Determine a "Flash Factor," using the NFPA Flammable Hazard Rating (the RED diamond on the NFPA Hazard Identification System sign).

Enter the NFPA Flammable Hazard Rating. | 31 |

Step 2. Determine a "Reactivity Factor," using the NFPA Reactivity Hazard Rating System (the YELLOW diamond on the NFPA Hazard Identification System sign).

Enter the NFPA Reactivity Hazard Rating. | 32 |

Step 3. Determine "Chemical Factor."

		Reactivity Factor (line 32)			
		1	2	3	4
Flash Factor (line 31)	1	7	9	12	15
	2	10	12	15	20
	3	12	15	18	25
	4	13	15	20	25

Select the Chemical Factor from the chart above. | 33 |

Part B. Determination of Damage Consequence Category

Quantity Factor (QF)

The Quantity Factor represents the largest amount of material which could be released from a unit in a single scenario.

The Quantity Factor is taken directly from the chart below. For amount of material released, use the largest amount of flammable inventory that can be lost in a single leak event.

Material Released	Quantity Factor
<1,000 pounds	15
1K–2K pounds	20
2K–10K pounds	25
10K–30K pounds	28
30K–80K pounds	31
80K–200K pounds	34
200K–700K pounds	37
700K–1 million	39
1–2 million	41
2–10 million	45
> million	50

Enter the appropriate value from the table above. This is the Quantity Factor. | 34 |

State Factor

The State Factor is dependent on the normal boiling point of the fluid, an indication of the fluid's tendency to vaporize and disperse when released into the environment.

Select a State Factor based on the normal (atmospheric pressure) boiling temperature (T_b) in degrees Fahrenheit.

T_b (°F)	State Factor
below –100	8
–100 to 100	6
100 to 250	5
250 to 400	1
above 400	–3

Select the appropriate value from the table above. This is the State Factor. | 35 |

Part B. Determination of Damage Consequence Category

Autoignition Factor (AF) The Autoignition Factor is a penalty applied to fluid that is processed at a temperature above its autoignition temperature.		
If a fluid is processed below its AIT, enter –10 If the fluid is processed above its AIT, use the following table to determine AF, based on the normal boiling point of the fluid (in degrees Fahrenheit). T_b (°F) — AF Factor below 0 — 3 0 to 300 — 7 above 300 — 13		
Enter the appropriate value from the table above. This is the Autoignition Factor.	36	
Pressure Factor (PRF) The Pressure Factor represents the fluid's tendency to be released quickly, resulting in a greater chance of instantaneous-type effects.		
• If the fluid is a liquid inside the equipment, enter –10. • If the fluid is a gas inside the equipment, and at a pressure of greater than 150 psig, enter –10. • If neither of the above conditions are true, enter –15.		
Select the appropriate value from the table above. This is the Pressure Factor.	37	

Part B. Determination of Damage Consequence Category

Credit Factor (CF) The Credit Factor is the product of several subfactors of engineered systems in place which can reduce the damage from an event.		
If there is gas detection in place which would detect 50% or more of incipient leaks, enter –1, otherwise, enter 0.	38	
If process equipment is normally operated under an inert atmosphere, enter –1, otherwise enter 0.	39	
If fire-fighting systems are "secure" in the event of a major incident (e.g. fire water system will remain intact in the event of an explosion), enter –1, otherwise enter 0.	40	
If the isolation capability of the equipment in this area can be controlled remotely, AND: • the isolation and associated instrumentation is protected from fires and explosions, then enter –1, • OR, if the isolation and associated instrumentation is protected from fires only, enter –1, • OR, if there is no protection for the isolation capability from fires or explosions, enter –1,		
otherwise, enter 0.	41	
If there are blast walls around the most critical (typically highest pressure) equipment, enter –1, otherwise enter 0.	42	
If there is a dump, drain, or blowdown system which will deinventory 75% or more of the material in 5 minutes or less, with 90% reliability, enter –1, otherwise enter 0.	43	
If there is fireproofing in place on both structures and cables, enter –1, if there is fireproofing on either structures or cables, enter 0.95, otherwise enter 0.	44	
If there is a fire water supply which will last at least 4 hours, enter –1, otherwise enter 0.	45	
If there is a fixed foam system in place, enter –1, otherwise enter 0.	46	
If there are firewater monitors which can reach all areas of the affected unit, enter –1, otherwise enter 0.	47	
Add lines 38 through 47. This is the Credit Factor.	48	

Part B. Determination of Damage Consequence Category

Damage Consequence Category		
Step 1. Determine the Damage Consequence Factor. Add lines 33, 34, 35, 36, 37, and 48 together, this is the Damage Consequence Factor.	49	
Step 2. The Damage Consequence Factor (line 49) is then converted into a Damage Consequence Category based on the table below:		
Enter the Damage Consequence Category.	50	

Consequence Factor	Consequence Category
0–19	A
20–34	B
35–49	C
50–79	D
> 70	E

LAMPIRAN II

LONGITUDINAL JOINT FACTOR DAN TEMPERATURE DERATING FACTOR UNTUK BAJA [7]

Table 841.114A Basic Design Factor, *F*

Location Class	Design Factor, *F*
Location Class 1, Division 1	0.80
Location Class 1, Division 2	0.72
Location Class 2	0.60
Location Class 3	0.50
Location Class 4	0.40

Table 841.115A Longitudinal Joint Factor, *E*

Spec. No.	Pipe Class	*E* Factor
ASTM A 53	Seamless	1.00
	Electric Resistance Welded	1.00
	Furnace Butt Welded: Continuous Weld	0.60
ASTM A 106	Seamless	1.00
ASTM A 134	Electric Fusion Arc Welded	0.80
ASTM A 135	Electric Resistance Welded	1.00
ASTM A 139	Electric Fusion Welded	0.80
ASTM A 211	Spiral Welded Steel Pipe	0.80
ASTM A 333	Seamless	1.00
	Electric Resistance Welded	1.00
ASTM A 381	Double Submerged-Arc-Welded	1.00
ASTM A 671	Electric Fusion Welded	
	Classes 13, 23, 33, 43, 53	0.80
	Classes 12, 22, 32, 42, 52	1.00
ASTM A 672	Electric Fusion Welded	
	Classes 13, 23, 33, 43, 53	0.80
	Classes 12, 22, 32, 42, 52	1.00
API 5L	Seamless	1.00
	Electric Resistance Welded	1.00
	Electric Flash Welded	1.00
	Submerged Arc Welded	1.00
	Furnace Butt Welded	0.60

GENERAL NOTE: Definitions for the various classes of welded pipe are given in para. 804.243.

Table 841.116A Temperature Derating Factor, *T*, for Steel Pipe

Temperature, °F	Temperature Derating Factor, *T*
250 or less	1.000
300	0.967
350	0.933
400	0.900
450	0.867

GENERAL NOTE: For intermediate temperatures, interpolate for derating factor.

LAMPIRAN III

TOXICITY, FLAMMABILITY, DAN REACTIVITY FAKTOR PADA NFPA [17]

	Health Hazard
4	*Very short exposure could cause death or serious residual injury even though prompt medical attention was given.*
3	*Short exposure could cause serious temporary or residual injury even though prompt medical attention was given.*
2	*Intense or continued exposure could cause temporary incapacitation or possible residual injury unless prompt medical attention is given.*
1	*Exposure could cause irritation but only minor residual injury even if no treatment is given.*
0	*Exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials.*

	Flammability
4	*Will rapidly or completely vaporize at normal pressure and temperature, or is readily dispersed in air and will burn readily.*
3	*Liquids and solids that can be ignited under almost all ambient conditions.*
2	*Must be moderately heated or exposed to relatively high temperature before ignition can occur.*
1	*Must be preheated before ignition can occur.*
0	*Materials that will not burn.*

	Reactivity
4	*Readily capable of detonation or of explosive decomposition or reaction at normal temperatures and pressures.*
3	*Capable of detonation or explosive reaction, but requires a strong initiating source or must be heated under confinement before initiation, or reacts explosively with water.*
2	*Normally unstable and readily undergo violent decomposition but do not detonate. Also: may react violently with water or may form potentially explosive mixtures with water.*
1	*Normally stable, but can become unstable at elevated temperatures and pressures or may react with water with some release of energy, but not violently.*
0	*Normally stable, even under fire exposure conditions, and are not reactive with water.*

LAMPIRAN IV

KOMPOSISI KIMIA GAS ALAM

1. HASIL ANALISA GAS

LOKASI	KOMPOSISI FRAKSI											
SAMPLE	N 2	CO2	CH4	C2H6	C3H8	IC4H10	NC4H10	IC5H12	NC5H12	C6H14 +	TOTAL	S G	GHV BTU / SCF
PGN BITUNG	0,0593	0,1237	0,7671	0,0236	0,0141	0,0033	0,0032	0,0015	0,0008	0,0034	1,0000	0,7458	902,2279
PT. EHK (BITUNG)	0,0593	0,1237	0,7671	0,0236	0,0141	0,0033	0,0032	0,0015	0,0008	0,0034	1,0000	0,7458	902,2279
PGN CIKANDE	0,0593	0,1227	0,7663	0,0233	0,0143	0,0034	0,0034	0,0016	0,0009	0,0028	1,0000	0,7442	902,1412
MS CILEGON	0,0592	0,1240	0,7663	0,0240	0,0145	0,0034	0,0033	0,0015	0,0008	0,0030	1,0000	0,7459	901,7568
PT. SADIKUN	0,0592	0,1240	0,7663	0,0240	0,0145	0,0034	0,0033	0,0015	0,0008	0,0030	1,0000	0,7459	901,7568
PT. S P I J	0,0588	0,1233	0,7681	0,0237	0,0143	0,0034	0,0033	0,0015	0,0008	0,0028	1,0000	0,7442	901,5180
PGN CILEGON	0,0588	0,1233	0,7681	0,0237	0,0143	0,0034	0,0033	0,0015	0,0008	0,0028	1,0000	0,7442	901,5180