Click on incident name in "Event" column
to go directly to 1-Page incident summary.

Major Process Safety Incident vs Root Cause Map

(Quick Reference Guide)

Click on link to go directly
to investigation report.

Trevor Kletz famously observed that ***"Organisations have no memory. Only people have memory and they move on"*** . He also observed that ***"Accidents are not due to lack of knowledge, but failure to use the knowledge we have"*** .

This Refining Process Safety Incident database was inspired by these observations. Its purpose is simply to raise awareness of major incidents in the oil refining sector, to promote the importance of root cause analysis and to catalyse sharing of lessons learned and good practices. The infographic below provides an overview of the main root causes of each incident and enables the user to quickly identify which incidents share common root causes across multiple refining technologies. The document contains hyperlinks so the user can simply click on the incident name in the "Event" column to directly access a 1-Page incident summary or can click on the corresponding link in the "Investigation Reports" column to directly access the investigation report (where available in the public domain). The 1-Page incident summaries provide a brief description of the incident an highlight key points (including basic causes, critical factors, root causes and lessons learned) in addition to signposting users to the detailed investigation report and selected other pertinent reference materials.

The following definitions were used in development of these 1-Pagers:
- Near Miss is an undesirable event which, under different circumstances, could have resulted in a process safety incident.
- Immediate Cause (or Basic Cause) is a sub-standard act or condition that led directly to the incident.
- Critical Factor is an undesirable act or condition which, if eliminated, would have prevented occurrence or reduced the severity of the incident.
- Root Cause (or System Cause) is an organisational failing that created circumstances or conditions enabling the incident to take place.

							Context		"Natech" Triggers – Natural Hazards				
Process Type	**Date**	**Event**	**Country**	**Type**	**Fatalities**	**Injuries**	**Abnormal Operations**	**Escalation Potential**	**Earthquake**	**Tsunami**	**Flood**	**Cyclone/Hurricane**	**Extreme Cold/Ice**
Alkylation (H2SO4)	22-Nov-16	Baton Rouge	USA	Fire	0	4							
Alkylation (HF)	21-Jun-19	Girard Point	USA	Explosion	0	6		X					
Atmospheric Crude Distillation	23-Feb-99	Avon	USA	Fire	4	1	X						
Atmospheric Crude Distillation	17-Aug-99	Izmit	Turkey	Fire	0	0		X	X				
Atmospheric Crude Distillation	06-Aug-12	Richmond	USA	Fire	0	26							
Catalytic Reforming (CCR)	19-Nov-13	Antwerp	Belgium	Explosion	2	0							
Catalytic Reforming (S-R)	21-Aug-17	Rotterdam	Netherlands	Fire	0	0	X						
Fluid Catalytic Cracking	23-Jul-84	Romeoville	USA	Explosion	17	22							
Fluid Catalytic Cracking	09-Nov-92	La Mède	France	Explosion	6	38		X					
Fluid Catalytic Cracking	24-Jul-94	Milford Haven	UK	Explosion	0	26	X	X					
Fluid Catalytic Cracking	18-Feb-15	Torrance	USA	Explosion	0	4	X	X					
Fluid Catalytic Cracking	26-Apr-18	Superior	USA	Explosion	0	36	X	X					
Hydrocracking	22-Mar-87	Grangemouth	UK	Explosion	1	0	X	X					
Hydrocracking	21-Jan-97	Avon	USA	Runaway	1	46	X	X					
Hydrocracking	05-Nov-05	Delaware City	USA	Asphyxiation	2	0							
Naphtha Hydrotreating	02-Apr-10	Anacortes	USA	Explosion	7	0	X						
Naphtha Splitter	23-Mar-05	Texas City	USA	Explosion	15	180	X						
Oil Storage	04-Jan-66	Feyzin	France	BLEVE	18	84							
Oil Storage	11-Mar-11	Chiba	Japan	BLEVE	0	6		X	X				
Propane Deasphalting	16-Feb-07	McKee	USA	Fire	0	4		X					X
Saturated Gas Plant	16-Apr-01	Humber	UK	Explosion	0	5		X					

	Root Causes – Design Factors									Root Causes – Operations Factors						
Event	**Hazard Identification**	**Process Design**	**Equipment/Piping Design**	**Matterials of Construction**	**Instrumentation**	**Safety Instrumented Systems**	**Protective Systems**	**Plant Layout**	**Occupied Buildings**	**Process Monitoring**	**Process Control**	**Cyber Security Breach**	**Alarm Management**	**Creeping Change**	**Hazard Awareness**	**Operations Risk Assessment**
Baton Rouge	X		**X**												X	
Girard Point				X		X	X								X	
Avon	X													X		X
Izmit		X	X	X			X	X								X
Richmond				**X**												X
Antwerp			**X**							X	X			X		
Rotterdam						**X**				X			X			X
Romeoville	X			X											X	
La Mède	X							**X**	X	X						
Milford Haven			X		X					X			X			X
Torrance	X				X	X		X		**X**					X	
Superior	X			X	X			X		**X**	X				X	X
Grangemouth	X		X		X	**X**	X								X	
Avon	X				**X**	X				X			X			X
Delaware City															X	
Anacortes	X		X	**X**	X					X				X		X
Texas City	X	X			X				X	X				X		X
Feyzin		X	X				X								X	
Chiba			**X**				X	X						X		X
McKee	X	X				X	X	X								
Humber	X		X													

	Root Causes – Maintenance Factors								Root Causes – Personal			Root Causes – Competency				
Event	**Preventative Maintenance**	**Inspection/Testing**	**Material Degradation**	**Work Planning**	**Maintenance Risk Assessment**	**Energy Isolation**	**Control of Work**	**Housekeeping**	**Human Factors**	**Role Clarity**	**Personal Protective Equipment**	**Communication**	**Procedures**	**Training**	**Supervision/Leadership**	**Contractor Selection**
Baton Rouge					X		X		X			X	X	X		
Girard Point		**X**	X													
Avon	X	X	X	X		X	**X**						X	X	X	
Izmit			X						X			X		X		
Richmond		X	X												X	
Antwerp					X								X			
Rotterdam							X		X			X	X			
Romeoville		X	**X**										X			
La Mède		X	X		X											
Milford Haven	X	**X**	X				X		X			X		X		
Torrance	X	X	X		X	X	X						X		X	
Superior			X										X	X		
Grangemouth							X					X	X	X		
Avon		X							X			X	X	X	X	
Delaware City					X		**X**		X				X	X		
Anacortes			X										X			
Texas City	X		X				X		X	X		X	**X**	X		
Feyzin													**X**	X		
Chiba		X		X										X		
McKee		X			X											
Humber	X	X	X									X				

	Root Causes – Culture							Root Causes – Regulator			Links
Event	**Production over Safety**	**Normalisation of Deviance**	**Quality Assurance/Control**	**Management of Change**	**Failure to Learn**	**Emergency Preparedness**	**Process Safety Management**	**Design Standards**	**Land Use Planning**	**Regulatory Compliance Audits**	**Investigation Reports**
Baton Rouge		X			X		X	X			Click
Girard Point								X			Click
Avon	X			X			X				Click
Izmit						**X**	X			X	Click
Richmond	X					X	X	X	X		Click
Antwerp											Click
Rotterdam							X				Click
Romeoville								X			
La Mède							X	X		X	Click
Milford Haven				X		X	X				Click
Torrance				X	X		X				Click
Superior		X			X	X	X	X			Click
Grangemouth	X			X	X		X				Click
Avon	X	X		X	X		X				Click
Delaware City											Click
Anacortes		X					X	X		X	Click
Texas City	X	X		X	X		X			X	Click
Feyzin						X		X			Click
Chiba						X	X		X		Click
McKee				**X**				X			Click
Humber				**X**			X				Click

Observations:

1) These 21 incidents alone have resulted in 73 fatalities and 488 injuries.

2) The most common root causes of these incidents are: a) inadequate process safety management (15/21), b) inadequate operating/maintenance procedures (13/21), c) material degradation (12/21), d) inadequate hazard identification (12/21) and e) inadequate inspection/testing (11/21).

3) Other causal factors include: a) escalation potential (12/21), b) abnormal operation (9/21) and c) Natech triggers (3/21).