Flash Fire Risk Assessment for the Upstream Oil and Gas Industry

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1 Scope

1.1 General

This recommended practice (RP) provides guidance for the upstream oil and gas industry on hazard identification and risk assessment exercises to assess and mitigate the risk of human injury caused by exposure to a flash fire.

The scope of this document is limited to personnel exposed to the risk of hydrocarbon based flash fires in the upstream Exploration and Production sector of the oil and gas industry. In general, this group includes oil and gas production, drilling, well bore (well servicing) operations, and gas processing prior to interstate pipeline transportation.

1.2 Conditions of Applicability

This RP focuses on flash fires that result from the unexpected ignition of hydrocarbon vapors. Emergency preparedness (e.g. firefighting, hazmat response) for exposure to fire event greater than a flash fire is excluded from this RP and is addressed by NFPA and other standards organizations.

Arc flash, as discussed in NFPA 70E and its other related standards, are outside the scope of this document.

Maintenance, care, and limitation of various fire resistant clothing (FRC) materials are outside the scope of this document. These items are addressed by the manufacturer and clothing-related standards.

2 Terms, Definitions, Acronyms, and Abbreviations

2.1 Terms and Definitions

For the purposes of this document, the following definitions apply.

2.1.1
Class I, Division 1 location
A location in which ignitable concentrations of flammable gases or vapors are expected to exist under normal operating conditions or in which faulty operation of equipment or processes might simultaneously release flammable gases or vapors and also cause failure of electrical equipment.

2.1.2
Class I, Division 2 location
A location in which flammable gases or vapors may be present but normally are confined within closed systems; are prevented from accumulating by adequate ventilation; or the location is adjacent to a Division 1 location from which ignitable concentrations might occasionally be communicated.

2.1.3
Class I location
A location in which flammable gases or vapors are, or may be, present in the air in quantities sufficient to produce explosive or ignitable mixtures.

2.1.4
fire
A rapid oxidation process, which is a chemical reaction resulting in the evolution of light and heat in varying intensities.

2.1.5
fire resistant clothing
FRC
Apparel designed by the manufacturer to not increase the extent of injury experienced by the wearer when exposed to a hydrocarbon flash fire.

NOTE The acronym has been defined in the following ways by various industry and regulatory organizations (e.g. NFPA, CEN, CAN/CGSB, ISO, ASTM, etc.) as flame resistant clothing, fire retardant clothing, fire resistive clothing, and flame retardant clothing.

2.1.6
flash fire
A fire that spreads rapidly by means of a brief flame front through a diffuse fuel, such as gas or the vapors of an ignitable liquid, without the production of damaging pressure.

2.1.7
Greenfield site
A well site where neither oil nor gas has been brought to the surface from the formation. A production or processing facility where hydrocarbons have never been delivered via pipeline, flow line, tank truck, or processing equipment.

NOTE Water disposal sites are not Greenfield sites.

2.1.8
loss of containment
The unplanned or uncontrolled release of flammable hydrocarbon materials to the work environment.

2.1.9
lower explosive limit
LEL
The minimum concentration of flammable gas or vapor that supports self-propagating flame when mixed with air (oxygen) and ignited.

2.1.10
personal protective equipment
PPE
Clothing and equipment designed to protect personnel from workplace injuries or illnesses resulting from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards.

2.1.11
simultaneous operations
SimOps
When two or more activities or process operations are being performed concurrently in close proximity.

2.2 Acronyms and Abbreviations

CEN	European Committee for Standardization (based on French title: Comité Européen de Normalisation)
FRC	fire resistant clothing
LEL	lower explosive limit
PPE	personal protective equipment
SimOps	simultaneous operations

3 Flash Fire

3.1 General

Fires will occur when sources of ignition meet flammable vapor and air (oxygen) mixtures in the proper proportions within the flammable range.

3.2 Risk of Injury due to Flash Fire

Figure 1 shows the three elements required for a person to be at risk of exposure to a flash fire. To produce a flash fire, a hydrocarbon fuel vapor source must exist at or above the lower explosive limit (LEL) and it must be in proximity to an ignition source. A flash fire can exist without risk to a person, and a person must be in proximity to be at risk of injury.

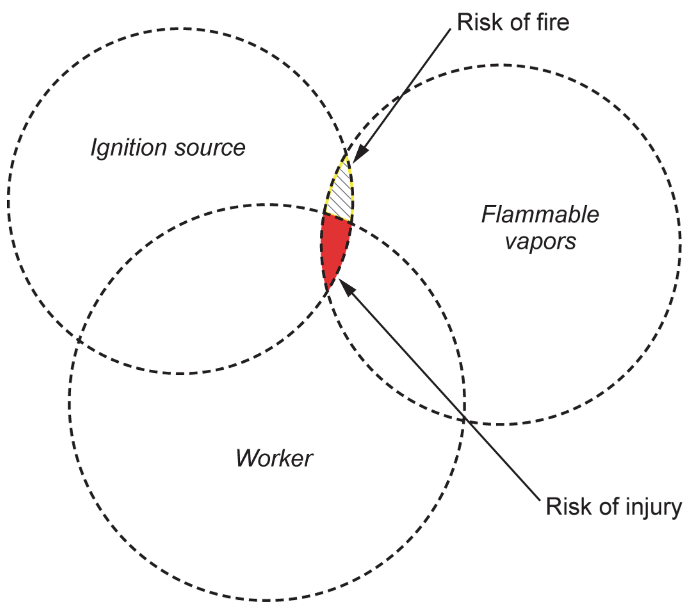

Figure 1—Risk of Flash Fire

The risk of injury to the person can be prevented in one of three ways:

a) prevent the fire by controlling the fuel source,

b) prevent the fire by controlling the ignition source,

c) prevent the person from being in proximity to the potential hazard.

FRC, when worn as designed, may lessen harm to a person exposed to a flash fire. The burn injuries to persons wearing clothing that ignites or melts are greater than the injuries received if clothing does not ignite.

It should NOT be assumed that the use of FRC will fully protect the exposed person from injury.

3.3 Class I Division 1 and Division 2 Locations; Flammable Vapor Illustrations

A knowledge of Class I locations can aid in the identification of areas with the potential for flammable mixtures and as such a potential need for controls. API 500 provides guidance and numerous illustrations for the determination of Class I locations in petroleum facilities. Examples of API 500 illustrations can be found in Annex A.

Conditions within a classified area may change, resulting in a change to the risk of flash fire. If hydrocarbons have not been introduced or have been removed, additional controls may not be needed. For example, if working on a purged and inert system or drilling through a zone that does not produce hydrocarbon vapors at the surface, no risk of flash fire would be expected.

4 Hazard Evaluation

4.1 General

Where potential flash fire hazards exist, employers shall conduct a risk assessment and utilize controls to mitigate the risk of flash fire injury. See Section 6 (“Mitigation”) and Section 7 (“General FRC Guidelines”).

4.2 Hazard Identification

This RP recognizes that hazard identification is done prior to risk assessment. The hazard assessment process should include an identification of fuel sources, ignition sources, and job tasks.

Risk assessments may take many forms, such as those included in Section 5 and the annexes. These tools are provided as a resource, blending hazard identification steps with risk assessment and mitigation. These worksheets are not intended to replace existing safe work practices that have been implemented. Employers may rely on established methods to identify the risk of flash fire such as job hazard analysis, job safety analysis, or other risk assessment techniques.

4.3 Simultaneous Operations (SimOps)

SimOps is a regular occurrence in the upstream Exploration and Production sector of the oil and gas industry and should be a consideration when determining the potential risk for flash fire. When SimOps occur, the operation with the highest flash fire risk level of all affected operations shall determine if FRC is utilized for the entire SimOps activity.

4.4 Loss of Containment

The employer shall evaluate the risk of loss of containment. If personnel are performing a task that increases the probability of release of flammable materials, the employer shall take steps to mitigate the risk.

As part of this risk assessment the employer shall consider the following questions.

a) Is the worker doing a task that increases the risk of loss of containment?

b) Will the product released produce a flammable vapor?

c) What controls are currently in place to minimize the risk of the flammable vapors to the air?

d) What controls can be put in place to minimize the risk of a release?

The concept of performing a flash fire risk assessment that evaluates the inherent risk of materials while considering the risk of loss of containment is consistent with established industry standards. Flammable gases (NFPA Hazard Level 4 as defined in NFPA 704) are usually vapors and are ignitable at normal temperatures if a process is open under normal atmospheric conditions. Flammable liquids (NFPA Hazard Level 3) are usually ignitable at normal temperatures if a process is open. Less hazardous (NFPA Hazard Rating 2 or 1) materials produce flammable vapors if heated above their flash point. If containment failure occurs with flammable gases, liquids or heated combustible liquids the worker is exposed to the risk of flash fire.

5 Risk Assessment Methods

5.1 General

Many methodologies are available to assess the risks associated with activities that pose a flash fire hazard. Using the appropriate methodology will promote a better understanding of the risk and the necessary mitigation measures. The employer is responsible for determining which assessment methodology best suits their needs.

Consideration should be given to various factors during a risk assessment including, but not limited to, the following:

a) proximity of the workers to the flash fire hazard;

b) potential for the task creating loss of containment (e.g. line breaking);

c) current operations (drilling, completions, production, construction, gas processing, etc.);

d) engineering controls to reduce the likelihood or consequences of flammable releases;

e) flash fire accident history;

f) means and duration of egress from the potential flash fire exposure zone;

g) multiple fuel sources;

h) chemical exposure;

i) SimOps.

Other conditions might reduce the risk of flash fire. For example, process piping that contains heavy oil may be in good condition and operating well within safe operating pressures. Proper design and maintenance of the system is considered effective engineering control.

5.2 Example Risk Assessment Technique

The Bowtie Model is an assessment technique that uses a visual representation to illustrate the risk factors. The exposure to a flash fire (which is the critical event of concern) is placed centrally between the threats on the left (i.e. the factors that can result in a flash fire) and the consequences on the right (the potential adverse results if the flash fire were to occur). Potential consequences would range from “no consequences” to “fatal result.” Prevention measures are the “defense barriers” expected to prevent a threat (on the left side) leading to a flash fire. Mitigation measures (on the right side) are the “defense barriers” that prevent damage and/or reduce its severity. The effectiveness of each “defense barrier” may be reduced by degrading factors (e.g. lack of training).

Following completion of the bowtie model(s), an assessment of the adequacy of the identified “defense barriers” should be completed. Each operation/activity for which a bowtie was created should be assessed. For each operation/activity, the threats and consequences are given a preliminary risk evaluation (low, medium, or high). For each threat/consequence, the defense barriers are listed and the resultant risk levels are determined.

Annex B shows an example of a blank bowtie as well as an example of how to complete the bowtie for a flash fire risk assessment.

5.3 Flash Fire Risk Assessment Worksheets and Coversheet

Annex C provides a 1-page overview/checklist for conducting a risk assessment. This document would be an appropriate format to use as a cover page for a series of assessments.

The employer can use Annex D or other techniques to illustrate the adequacy of the "defense barriers."

5.4 Illustrated Risk Assessment for Oil and Gas Operations

As examples, the Flash Fire Risk Assessment Coversheet and Worksheets have been filled out in Annex E to show scenarios that can be encountered.

6 Mitigation

6.1 Layers of Protection

Safe operations are the result of layers of protection or safeguards. These layers of protection are put in place to prevent an incident from occurring or mitigate the consequences of an event. Protective layers shall be maintained to ensure effectiveness. Stronger and more numerous independent protection layers will lessen the likelihood that an event will occur or result in harm.

Flash fire injuries result from a failure of several protection layers. Flammable vapor must be present at concentrations at or above the LEL, which results from the failure of safeguards designed to ensure containment within equipment and piping, and there must also be an ignition source. Safe work practices, LEL monitoring, electrical area classification, etc. are layers of protection intended to prevent ignition sources while flammable vapor is present.

Personnel would need to be present at the location of the fire for an injury to occur. Site control and proximity exclusion prevent exposure. In the event other protective measures fail, garment selection and PPE offers a final layer of protection intended to lessen injury severity.

6.2 Hierarchy of Controls

The selection of controls for mitigating hazards identified during a risk assessment should be based upon the hierarchy of controls. The traditional hierarchy of controls is illustrated in Figure 2.

The hierarchy of controls illustrates that methods at the top of the list are potentially more effective and protective than those at the bottom. Proper utilization of the hierarchy of controls can lead to the implementation of safer systems where the risk of illness or injury has been substantially reduced.

Elimination and substitution, while most effective at reducing hazards, also tend to be the most difficult to implement in an existing process. If the process is still at the design or development stage, elimination and substitution of hazards may be inexpensive and simple to implement. This is the theory behind the safety-through-design protocols. For an existing process, major changes in equipment and procedures may be required to eliminate or substitute for a hazard.

Engineering controls are used to remove a hazard or place a barrier between the worker and the hazard. Engineering controls can be effective in protecting workers and should be independent of worker. The initial cost of engineering controls can be higher than the cost of administrative controls or personal protective equipment (PPE); but over the longer term, operating costs are frequently lower and, in some instances, can provide a cost savings in other areas of the process. Equipment and engineering controls associated with protecting against flash fires shall be designed, installed, inspected, tested, and maintained before being considered adequate control.

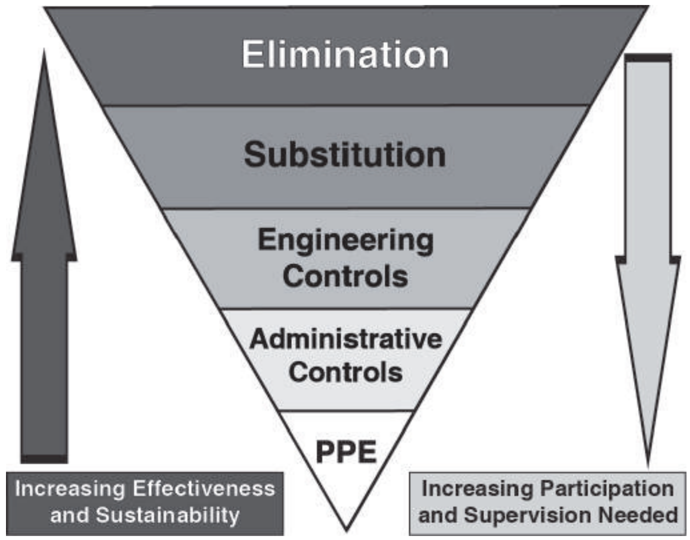

Figure 2—Hierarchy of Controls Illustration

Administrative controls and PPE are frequently used with existing processes where hazards are not mitigated with other controls. These methods for protecting workers have also proven to be less effective than other measures, requiring significant effort by the affected workers and supervisors. PPE and administrative controls shall be implemented and enforced. Employees shall be trained on implementation and purpose of each control that directly affects the employee.

If conditions at the site change that would affect the hazard/risk assessment, then the hazard/risk assessment shall be reviewed and updated to address the changes.

6.3 FRC Selection Based on Risk Assessment

If a risk assessment identifies the risk of a flash fire, the employer shall take appropriate steps to mitigate the risk to employees including the use of engineering controls or administrative controls. If the risk of flash fire is not mitigated, FRC can be required to safely perform a task.

FRC can minimize the severity of an injury but does not provide complete protection from a flash fire.

The FRC use decision tree (see Annex F) is designed to be used in determining when FRC should be worn by utilizing a flow charting method. When using this flow chart, the user works through a series of decision boxes to determine the FRC needs based on knowledge of the operation and the hazard. This method minimizes the amount of time that is required to perform a hazard assessment; however, it can increase the activities covered by the use of FRC since it reduces the amount of information needed to make the decision.

FRC should be worn by personnel working in areas where the risk assessment indicates that the work increases the probability of loss of containment of these materials.

a) Processes involving NFPA Hazard Level 4 (flammable gases) where flammable vapors will be present only if loss of containment occurs.

b) Processes involving NFPA Hazard Level 3 (flammable liquids) that are above their flash points in the operation and where flammable vapors will be present only if loss of containment occurs.

c) Processes involving materials with NFPA Hazard Level 2 or 1 (combustible liquids) when heated above their boiling points, where flammable vapors will be present only if loss of containment occurs and experience indicates a history of loss of containment incidents with a particular equipment arrangement.

7 General FRC Guidelines

The employer shall complete a risk assessment for their operations to identify and mitigate risk of flash fire injury. An alternative to documenting a flash fire risk assessment is to use the following general FRC guidelines and require FRC for personnel as indicated. Greenfield operations (no hydrocarbons present) do not require the use of FRC.

The bullet points below are intended to provide general guidance and are grouped with the operation where the particular action is often encountered. It should be noted that many of these activities occur in multiple operations. For example, pig launchers and compressors are operated in production and gas processing. This list is not all-inclusive.

a) Drilling.

— FRC is not generally needed for rig-up or rig-down.

— FRC is not generally needed for drilling water wells.

— Flash fire risk is dependent upon the type of hydrocarbon formation zone that may be drilled into/through. Drilling into a hydrocarbon bearing zone that has the potential to release hydrocarbon vapors to the atmosphere may raise the risk for flash fire. In these conditions, personnel working within Class 1, Division 1 and Division 2 areas [within 10 ft (3.3 m) of the shale shaker(s), mud tanks, well bore, or rotary table].

— Handling of flammable liquids.

b) Completions and well servicing.

— Class 1, Division 1 and Division 2 areas.

— FRC may not be needed during rig up or rig down, depending on status of wellbore.

— Any operation over or within 10 ft (3.3 m) of an open wellbore or a frac flowback tanks.

— From the beginning of perforating operations, through fracture operations.

— Flowback until iron is depressurized and the well is secured.

— Handling of flammable liquids.

c) Gas processing.

— Class 1, Division 1 and Division 2 areas.

— Personnel within 10 ft (3.3 m) of gas processing equipment and piping.

— Opening process equipment or a storage vessel that may contain hydrocarbons.

— Maintenance conducted on natural gas compressors.

— Opening pig launchers or receivers.

— Handling of flammable liquids (obtaining liquid samples).

d) Production.

— Class 1, Division 1 and Division 2 areas.

— Opening a thief hatch.

— Opening process equipment or a storage vessel that may contain hydrocarbons.

— Manually lighting burners and fired equipment (stick and rag, hand-held torch, etc.).

— Handling of flammable liquids.

— Transferring liquid hydrocarbons or produced water into or out of a transport truck.

— Venting and blowing down process equipment.

e) SimOps.

— Class 1, Division 1 and Division 2 areas.

— Any combination of complex operations (two or more of drilling, production, frac, flowback, etc.).

— High risk activities such as hot-tap and in-service welding.

Annex A
(informative)

Examples of API 500 Illustrations

Figure A.1 through Figure A.6 are example illustrations that depict the electrical classification of petroleum facilities.

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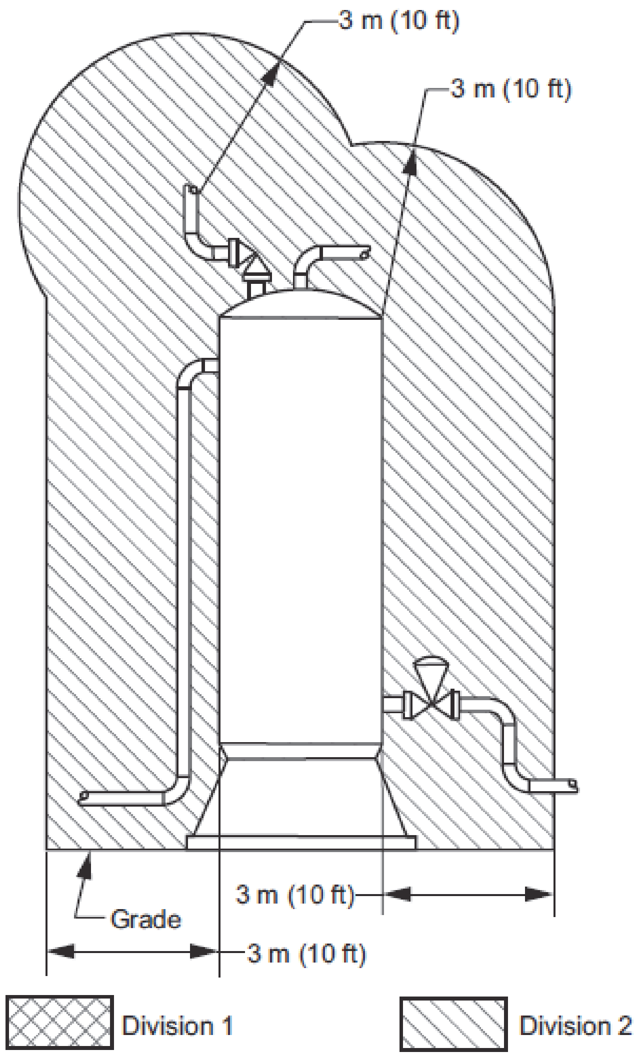


Figure A.1—Hydrocarbon Pressure Vessel or Protected Fired Vessel in a Nonenclosed Adequately Ventilated Area

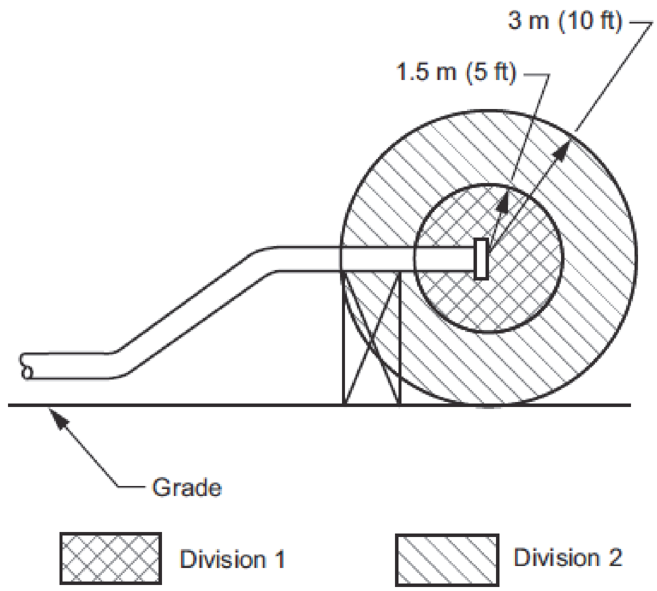


Figure A.2—Ball or Pig Launching or Receiving Installation in a Nonenclosed Adequately Ventilated Area

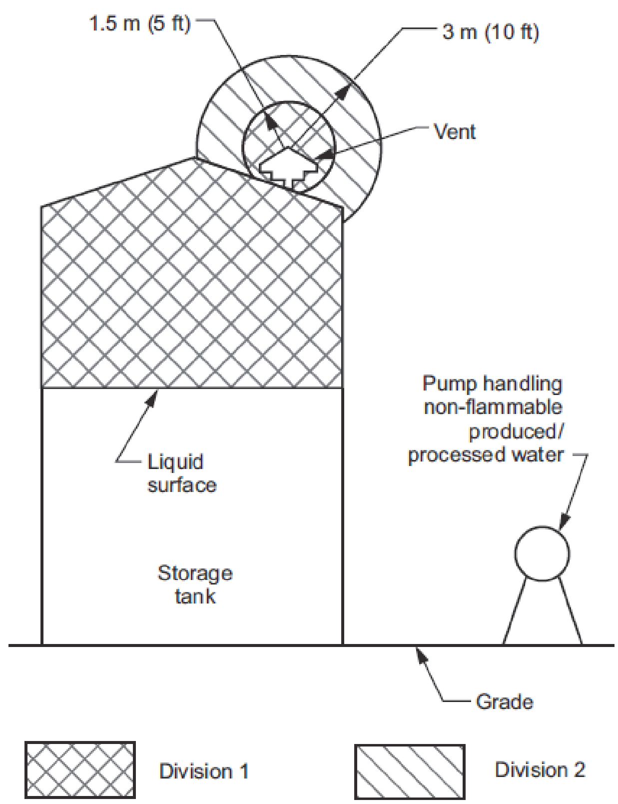


Figure A.3—Flammable Gas-blanketed and Produced Water-handling Equipment in a Nonenclosed Adequately Vented Area

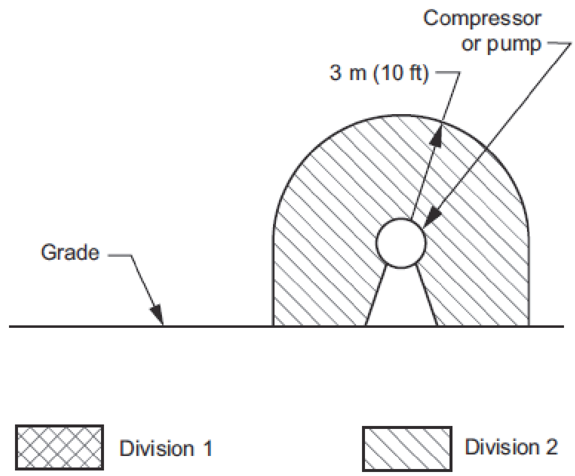
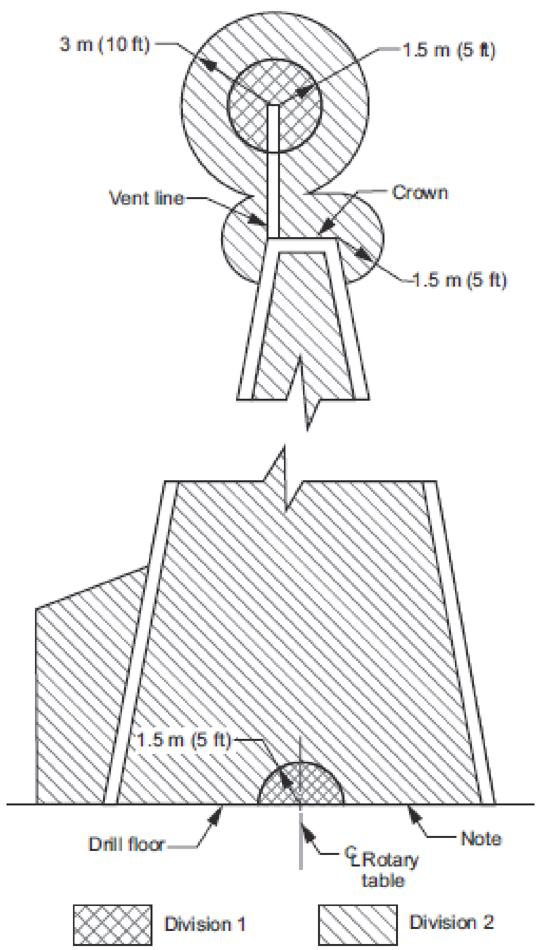


Figure A.4—Compressor or Pump in an Adequately Ventilated Nonenclosed Area



NOTE See applicable substructure diagrams for classification below the drill floor.

Figure A.5—Drilling Rig Derrick Fully Enclosed (Open Top)

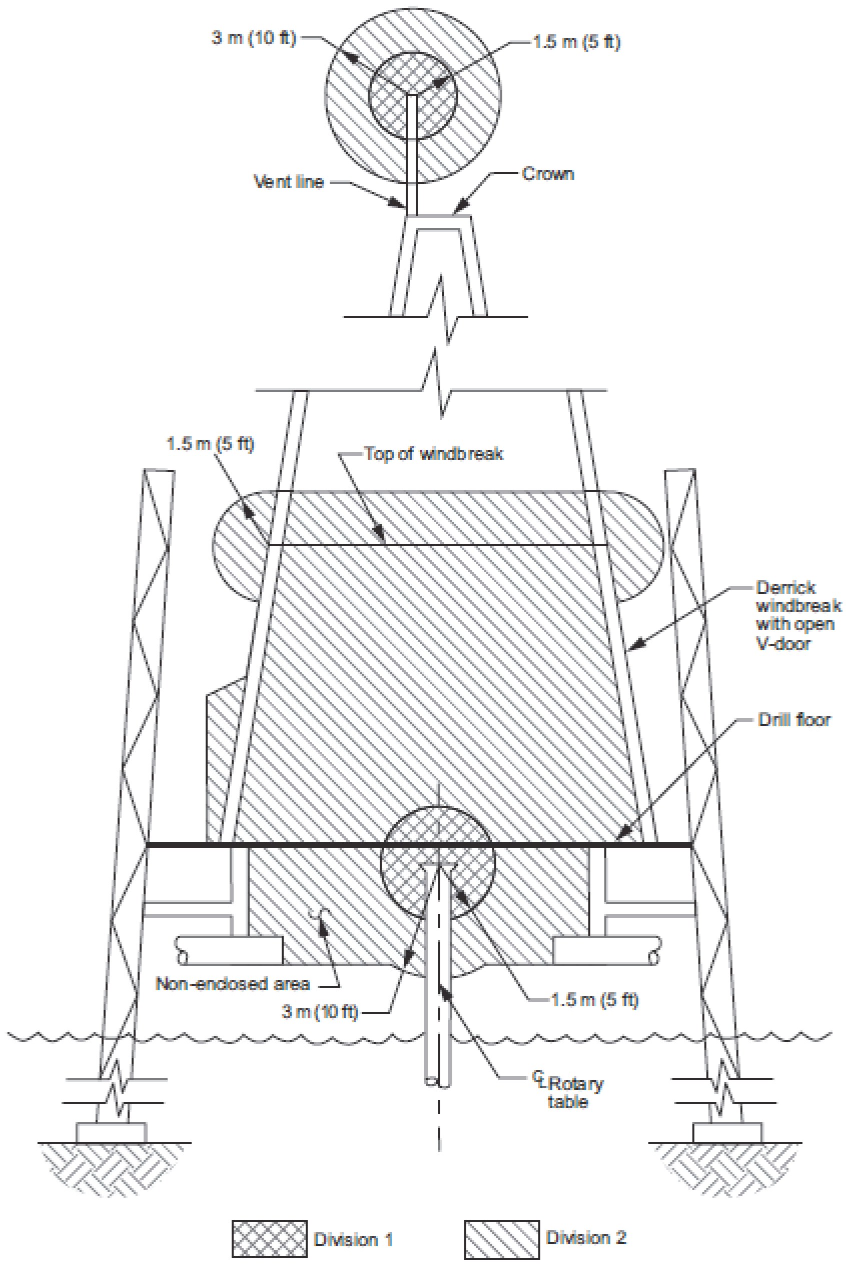


Figure A.6—Drilling Rig Open Substructure and Semi-enclosed Derrick

Annex B
(informative)

Bowtie Model

B.1 FRC Bowtie Worksheet

Figure B.1 provides an example FRC Bowtie Worksheet.

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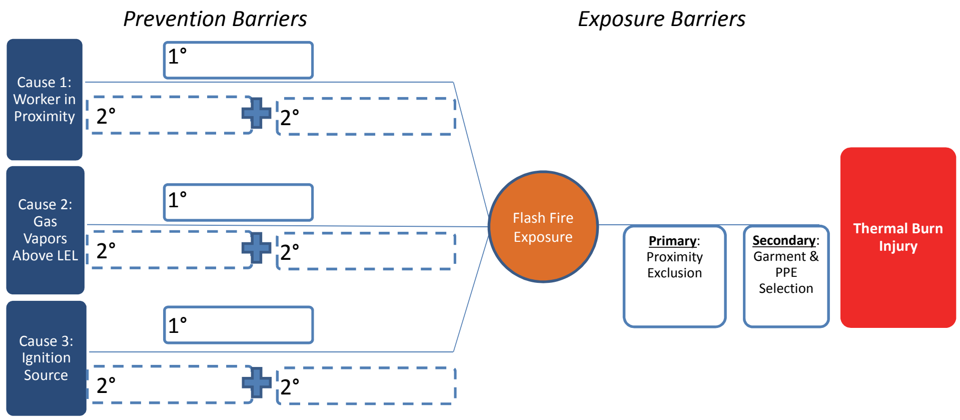
Identify Task, Location, Operation:____

Date, Supervisor, Company:____



A single 1° Prevention Barriers will break the line between Cause and Event. Engineering Controls can be an example of 1° Prevention Barriers

2° Prevention Barriers can be combined to reduce the risk of flash fire event to ALARP. Procedures and Training are examples.

Engineering Controls (partial list)	Administrative Controls (partial list)
(1) Flare assemblies to burn off gas resulting from the treater-separator process. (2) Pop-off valves that release pressure. (3) Diked areas or berms that contain any liquid spills. (4) Fiberglass water tanks and lightning rods. (5) Chokes to control the flow of well fluid to the treater-separator unit. (6) Lines that collect the gas blanket from the top of the tanks and direct it towards the flare pit. (7) Physical separation between elements that may cause explosions. (8) Grounded tanks to release static electricity. (9) Automatic controls for the gas going to the pilot light. ______________________________ ______________________________	(1) Procedures for ____________________. (2) Protocols for gauging tanks, including the use of grounding and bonding connections to prevent the buildup of static electricity. (3) Safety meetings to review safe work practices. (4) Training. (5) LEL meter. ______________________________ ______________________________ ______________________________ ______________________________

Figure B.1—Example FRC Bowtie Worksheet

B.2 Bowtie Example

Figure B.2 provides an example of how to complete a Bowtie assessment.

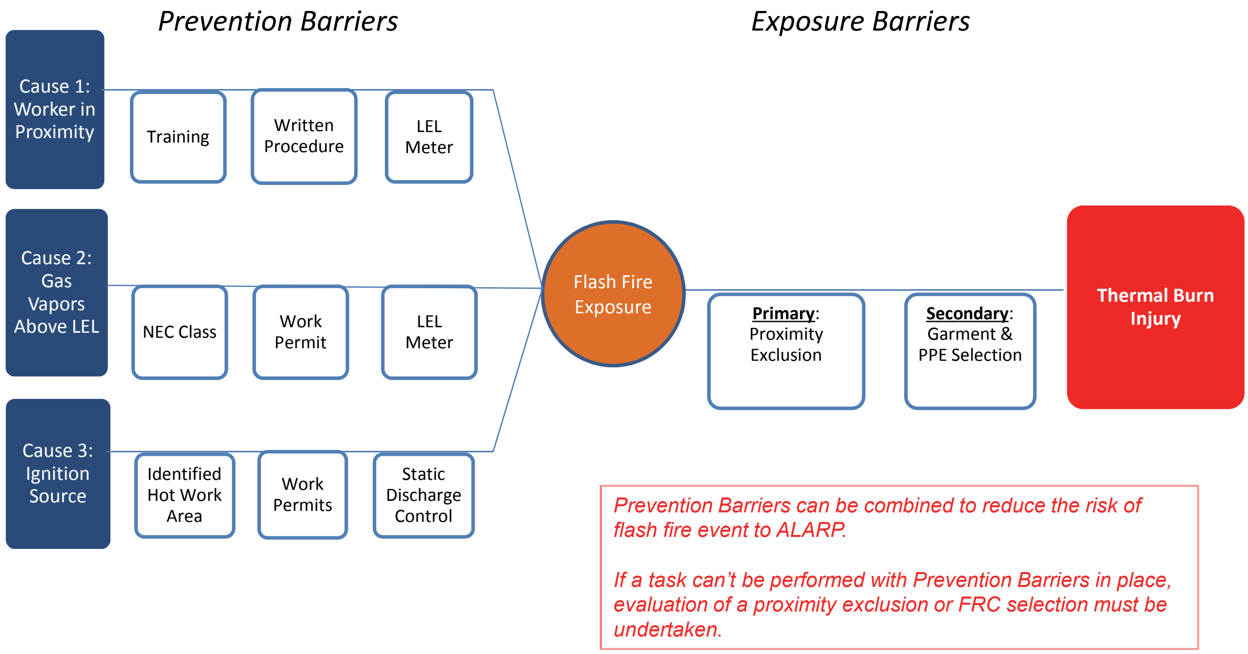


Figure B.2—Flash Fire Bowtie Example

Prevention barriers exist in the form of various engineering and administrative controls (see Table B.1). Each employer may identify and utilize other prevention barriers.

Table B.1—Flash Fire Engineering and Administrative Controls

Engineering Control Partial List	Administrative Control Partial List
(1) Flare assemblies to burn off gas resulting from the treater-separator process. (2) Pressure safety valves that release to atmosphere. (3) Diked areas or berms that contain any liquid spills. (4) Chokes to control the flow of well fluid to the treater-separator unit. (5) Lines that collect the gas blanket from the top of the tanks and direct it towards the flare pit. (6) Physical separation between fuel and ignition source. (7) Grounded and bonded equipment and tanks. (8) Automatic controls for gas going to the pilot light.	(1) Procedures for lighting heater/treater. (2) Protocols for gauging tanks, including the use of grounding and bonding connections to prevent the buildup of static electricity. (3) Safety meetings to review safe work practices. (4) Training.

Annex C
(informative)

Flash Fire Risk Assessment Coversheet

C.1 The Risk Assessment Coversheet shown in Figure C.1 may be used to summarize the conclusions from the Flash Fire Risk Assessment Worksheet (Annex D), and it may also identify hazards not related to flash fire that must be mitigated. This document is not all inclusive and is provided as a basic guide for documenting a risk assessment. Complex operations may require additional documentation and more robust assessment techniques.

C.2 This coversheet contains the following sections.

a) Header—Identify the location and persons performing the assessment, and note local weather conditions.

b) Operation—Mark the box for the operation being assessed. If the desired operation is not on the list, select the box with a blank and write the operation into that line.

c) Hazard Framework—The scope of this document is limited to normal upstream oil and gas operations where process upset is a possibility or failed containment can occur in rare circumstances. Select the highest risk exposure based on input from the person(s) performing the evaluation, and base the remainder of the risk assessment on this level of exposure.

   If "Uncontrolled Pressure Release" or "Fire Response" are selected, the assessors must consider their emergency response plan. The scope of this document does not include preparedness for response to an event more significant than a brief flash fire.

d) The Scope of Risk Assessment may be focused on any of the following.

   — Facility/area assessments are limited to the boundaries of an operating facility, plant, well site, etc.

   — Task-specific assessments are focused on a particular job, such as a thiefing a tank, welding in a shop, or driving a field truck. Task assessments may be limited to a particular location with different risks identified at a different location.

   — Operation assessments are based on the selection made above. Risk may differ between different locations.

e) The Primary Risk Assessment includes the following.

   — Identify hazards using the list provided, selecting the "Yes" box as appropriate. If hazards are present beyond the list, fill in the blank and select the "Yes" box. If more than six hazards are identified, then a more robust risk assessment may be required.

   — Rank the hazards using the simplified risk matrix provided on a scale of 0 to 3, with 3 being most likely to occur with most severe results if exposure occurs. Each hazard should be ranked and it is possible for hazards to have the same risk rank.

f) Risk Mitigation—This should be documented for each hazard ranked 2 or 3 in the primary risk assessment. Engineering or administrative controls should be evaluated. In the last column, indicate whether the risk has been mitigated. If all risk is mitigated, PPE may not be required.

g) PPE Required—This section should include PPE needed based on the assessment and unmitigated risk. The assessors shall consider the limitations of PPE.

h) Secondary Risk Assessment can identify additional hazards created by PPE. For example, consider a situation where a worker is handling hazardous chemicals in a classified area. Chemical protective apron and gloves are needed due to chemical exposure and FRC is required due to flash fire risk. Wearing two layers of PPE can create mobility hazards and undue heat stress if the work environment is excessively hot.

Risk Assessment

Location ______________________

Site Conditions ______________________

Persons Completing Assessment ______________________

1 Operation

☐ Production ☐ Completions ☐ Drilling ☐ Construction ☐ SIMOPS

☐ Midstream ☐ ______________

2 Hazard Framework

☐ Normal Operations ☐ Normal Operations, Process Upset ☐ Failed Containment ☐ Uncontrolled Pressure Release ☐ Fire Response

3 Scope of Risk Assessment

☐ Facility/Area: ____________ ☐ Task: ____________ ☐ Operation: ____________

4 Primary Risk Assessment: Identify Hazards

No Yes (Rank if Yes)

☐ ☐ ☐ 1) Ignite Flammable Vapors
a) (list fuel sources) ______________________
b) (ignition sources) ______________________

☐ ☐ ☐ 2) Ignite Pressurized Oil Spray

☐ ☐ ☐ 3) Heat Stress

☐ ☐ ☐ 4) Chemical Exposure

☐ ☐ ☐ 5) ______________________

☐ ☐ ☐ 6) ______________________

Rank the Hazards

(Severity and Likelihood of occurrence increase from lower left to upper right)

Most

1	2	3
1	2	2
0	1	1

Potential Severity of Consequences

Least Likely to Occur

5 Risk Mitigation

For each Hazard Ranked 3 (High) or 2 (Medium), list Engineering and Administrative Controls that are being used. Control fuel source and ignition source first.

Hazard	Eng. Control	Admin. Control	Risk Mitigated?

6 PPE Required

List PPE, including FRC indicated by the Primary Risk Assessment:

____

7 Secondary Risk Assessment

If PPE presents additional hazards, describe how to mitigate the risk:

____

____

Figure C.1—Flash Fire Risk Assessment Coversheet

Annex D
(informative)

Flash Fire Risk Assessment Worksheet

D.1 The Flash Fire Risk Assessment Worksheet is provided as a framework for the risk assessment team to identify the basic stages in an operation and determine if flash fire hazards are possible and how to mitigate the risk of injury.

The worksheet shown in Figure D.1 contains the following sections.

a) Operation, Location, and Company should be identified in the blank provided.

b) Persons Performing Risk Assessment should be clearly identified.

c) Conditions of Well Site that are relevant to a flash fire risk assessment should be identified such as: oil/gas/water well, oil/water based mud, SIMOPS, or other conditions affecting flash fire potential.

d) Operations—Identify the operation (drilling, production, gas processing, etc.) in terms used by the assessors.

D.2 Each of the following topics is addressed in a column in the worksheet.

a) Task or Area should be specifically identified. Similar tasks at other facilities or other areas could be confused.

b) Causes—In the second column, Causes 1, 2, or 3 are based on the Bowtie Model (Annex B). Indicate in the "Initial Risk" column whether conditions exist on site where any or all of the following potential causes can lead to a flash fire exposure:

   — Cause 1: Worker Proximity,

   — Cause 2: LEL Concentration,

   — Cause 3: Ignition Source.

c) Initial Risk Level for each cause should be indicated as "Low," "Medium," or "High."

d) Prevention Barriers will include Engineering and Administrative Controls that are utilized to mitigate the risk of Worker Proximity (Cause 1), LEL Concentration (Cause 2), or Ignition Source (Cause 3) leading to a flash fire event.

e) Final Risk Level After Barriers should be indicated as Low, Medium, or High.

f) FRC Needed?—Respond "No" for low risk, "Yes" for medium or high risk. Assessors should consider the combined risk of each cause. For example:

   — worker proximity may be high, but LEL concentration and ignition source may be low. If the worker is not exposed to the risk of flash fire, then FRC may not be required;

   — if final risk for each cause is high, then the situation should be reevaluated because the risk of flash fire is high and FRC garments do not provide total protection.

Operation, Location, Company:____

Persons Performing Risk Assessment:____________________________________

Conditions of Well Site (oil/gas/water well, oil/water based mud, SIMOPS, other conditions affecting flash fire potential).____________________________________

Operations:________________________________ Date:________________

Task or Area (Partial List)		**Initial Risk Level** Low/Med/Hi	**Prevention Barriers (Engineering/Administrative Controls)**	**Final Risk Level After Barriers**	**FRC Needed?**
	Cause 1: Worker Proximity				
	Cause 2: LEL Concentration				
	Cause 3: Ignition Source				
	Cause 1: Worker Proximity				
	Cause 2: LEL Concentration				
	Cause 3: Ignition Source				
	Cause 1: Worker Proximity				
	Cause 2: LEL Concentration				
	Cause 3: Ignition Source				
	Cause 1: Worker Proximity				
	Cause 2: LEL Concentration				
	Cause 3: Ignition Source				
	Cause 1: Worker Proximity				
	Cause 2: LEL Concentration				
	Cause 3: Ignition Source				
	Cause 1: Worker Proximity				
	Cause 2: LEL Concentration				
	Cause 3: Ignition Source				
	Cause 1: Worker Proximity				
	Cause 2: LEL Concentration				
	Cause 3: Ignition Source				
	Cause 1: Worker Proximity				
	Cause 2: LEL Concentration				
	Cause 3: Ignition Source				

Figure D.1—Flash Fire Risk Assessment Worksheet

Annex E
(informative)

Example Flash Fire Risk Assessment Coversheets and Worksheets

E.1 Example Drilling Coversheet and Worksheet

Figure E.1 and Figure E.2 provide examples of a completed Flash Fire Risk Assessment Coversheet and Worksheet respectively for a drilling operation.

NOTE The following examples are merely examples for illustration purposes only. They are not to be considered exclusive or exhaustive in nature. API makes no warranties, express or implied, for reliance on or any omissions from the information contained in this document.

E.2 Example Gas Processing/Midstream Coversheet and Worksheet

Figure E.3 and Figure E.4 provide examples of a completed Flash Fire Risk Assessment Coversheet and Worksheet respectively for a gas processing/midstream operation.

E.3 Other Example Risk Assessment Worksheet

E.3.1 Example Completions Worksheet

Figures E.5 provides an example of a Flash Fire Risk Assessment Worksheet for completions.

E.3.2 Example Production Operations Worksheet

Figures E.6 provides an example of a Flash Fire Risk Assessment Worksheet for production operations.

E.3.3 Example Drilling Worksheet with Special Conditions

Figures E.7 provides an example of a Flash Fire Risk Assessment Worksheet for a drilling operation with special conditions.

Risk Assessment

Location *Drilling Rig XYZ123*

Site Conditions *Tight Shale well, no HC zones above TD*

Persons Completing Assessment *Rig Manager, Safety Rep, Company Man*

1 Operation

- [ ] Production
- [ ] Completions
- [x] Drilling
- [ ] Construction
- [ ] SIMOPS
- [ ] Midstream
- [ ] ______

2 Hazard Framework

- [x] Normal Operations
- [ ] Normal Operations, Process Upset
- [ ] Failed Containment
- [ ] Uncontrolled Pressure Release
- [ ] Fire Response

3 Scope of Risk Assessment

- [ ] Facility/Area: ______
- [ ] Task: ______
- [x] Operation: ______

4 Primary Risk Assessment: Identify Hazards

[ ] [X] [1] 1) Ignite Flammable Vapors
a) (list fuel sources) *Gas from formation, fuel for rig engines*
b) (ignition sources) *Rig and truck engines*

[X] [ ] [ ] 2) Ignite Pressurized Oil Spray

[X] [ ] [ ] 3) Heat Stress

[ ] [X] [2] 4) Chemical Exposure

[X] [ ] [ ] 5) ______

[X] [ ] [ ] 6) ______

Rank the Hazards

(Severity and Likelihood of occurrence increase from lower left to upper right)

Most

1	2	3	Potential Severity of Consequences
1	2	2	
0	1	1	

Least — Likely to Occur

5 Risk Mitigation

For each Hazard Ranked 3 (High) or 2 (Medium), list Engineering and Administrative Controls that are being used. Control fuel source and ignition source first.

Hazard	Eng. Control	Admin. Control	Risk Mitigated?
Handling Methanol or Caustic			No

6 PPE Required

List PPE, including FRC indicated by the Primary Risk Assessment:

Use goggles, rubber gloves, a face shield, and apron when handling chemicals

7 Secondary Risk Assessment

If PPE presents additional hazards, describe how to mitigate the risk:

______

______

Figure E.1—Example Drilling Flash Fire Risk Assessment Coversheet

Operation, Location, Company: ____________________

Persons Performing Risk Assessment: ____________________

Conditions of Well Site (oil/gas/water well, oil/water based mud, SIMOPS, other conditions affecting flash fire potential). Tight shale well, drilling through known production zones.

Operations: Drilling Date: ____________

Task or Area (Partial List)		Initial Risk Level Low/Med/Hi	Prevention Barriers (Engineering/Administrative Controls)	Final Risk Level After Barriers	FRC Needed?
Location construction	Cause 1: Worker Proximity	Low			
	Cause 2: LEL Concentration	Low			No
	Cause 3: Ignition Source	Low			
Move rig to location	Cause 1: Worker Proximity	Low			
	Cause 2: LEL Concentration	Low			No
	Cause 3: Ignition Source	Med/High	Manage traffic, proper flammable storage		
Rig up	Cause 1: Worker Proximity	Low			
	Cause 2: LEL Concentration	Low			No
	Cause 3: Ignition Source	Medium			
Drill surface hole	Cause 1: Worker Proximity	Low			
	Cause 2: LEL Concentration	Low			No
	Cause 3: Ignition Source	Medium			
Run surface casing and cement	Cause 1: Worker Proximity	Low			
	Cause 2: LEL Concentration	Low			No
	Cause 3: Ignition Source	Medium			
Drill through gas/oil zone	Cause 1: Worker Proximity	Medium			
	Cause 2: LEL Concentration	Medium			Yes
	Cause 3: Ignition Source	Medium			
Run production casing	Cause 1: Worker Proximity	Medium			
	Cause 2: LEL Concentration	Medium			Yes
	Cause 3: Ignition Source	Medium			
Nipple up wellhead	Cause 1: Worker Proximity	Medium			
	Cause 2: LEL Concentration	Medium			Yes
	Cause 3: Ignition Source	Medium			

Figure E.2—Example Drilling Flash Fire Risk Assessment Worksheet

Risk Assessment

Location *Gas Processing Unit 1at Midstream Facility XYZ*

Site Conditions *Typical Gas Plant; no maintenance underway*

Persons Completing Assessment *Site Manager, Safety Rep*

1 Operation

- [ ] Production
- [ ] Completions
- [ ] Drilling
- [ ] Construction
- [ ] SIMOPS
- [x] Midstream
- [ ] ____________

2 Hazard Framework

- [x] Normal Operations
- [ ] Normal Operations, Process Upset
- [ ] Failed Containment
- [ ] Uncontrolled Pressure Release
- [ ] Fire Response

3 Scope of Risk Assessment

- [x] Facility/Area: ____________
- [ ] Task: ____________
- [ ] Operation: ____________

4 Primary Risk Assessment: Identify Hazards

No	Yes	(Rank if Yes)	Hazard
[ ]	[x]	2	1) Ignite Flammable Vapors a) (list fuel sources) *Compressors, PSV's, pig launcher, Loss of Containment* b) (ignition sources) *Electric motors, truck engines*
[x]	[ ]	[ ]	2) Ignite Pressurized Oil Spray
[x]	[ ]	[ ]	3) Heat Stress
[x]	[ ]	[ ]	4) Chemical Exposure
[x]	[ ]	[ ]	5) ____________
[x]	[ ]	[ ]	6) ____________

Rank the Hazards

(Severity and Likelihood of occurrence increase from lower left to upper right)

Most

1	2	3
1	2	2
0	1	1

Potential Severity of Consequences

Least

Likely to Occur

5 Risk Mitigation

For each Hazard Ranked 3 (High) or 2 (Medium), list Engineering and Administrative Controls that are being used. Control fuel source and ignition source first.

Hazard	Eng. Control	Admin. Control	Risk Mitigated?
Medium risk of flash fire	Facility design	Permits, Procedures, Training, LEL meters	Not fully

6 PPE Required

List PPE, including FRC indicated by the Primary Risk Assessment:

Standard PPE and FRC when entering process area or compressor building.

7 Secondary Risk Assessment

If PPE presents additional hazards, describe how to mitigate the risk:

____

____

Figure E.3—Example Gas Processing/Midstream Flash Fire Risk Assessment Coversheet

Operation, Location, Company:________________________________

Persons Performing Risk Assessment:________________________________

Conditions of Well Site (oil/gas/water well, oil/water based mud, SIMOPS, other conditions affecting flash fire potential).________________________________

Operations: *Gas processing upstream/midstream* Date:________________

Task or Area (Partial List)		Initial Risk Level Low/Med/Hi	Prevention Barriers (Engineering/Administrative Controls)	Final Risk Level After Barriers	FRC Needed?
Class 1 Division 1	Cause 1: Worker Proximity	*High*	*Signs, training, procedures*	*Medium*	*Yes*
	Cause 2: LEL Concentration	*High*	*LEL meter, permits, procedure*	*Medium*	
	Cause 3: Ignition Source	*Low*	*Facility design, procedures*	*Low*	
Class 1 Division 2-Dehydrator, amine unit, compressor building	Cause 1: Worker Proximity	*High*	*Signs, training, procedures*	*Medium*	*No*
	Cause 2: LEL Concentration	*Medium*	*LEL meter, permits, procedure*	*Low*	
	Cause 3: Ignition Source	*Low*		*Low*	
PSM facility boundaries *Loss of Containment must be considered*	Cause 1: Worker Proximity	*High*	*Signs, training, procedures*	*Medium*	*Yes*
	Cause 2: LEL Concentration	*Medium;*	*LEL meter, permits, procedure*	*Medium*	
	Cause 3: Ignition Source	*Low*		*Low*	
Multiple Class 1 Division 2 process units *Loss of Containment must be considered*	Cause 1: Worker Proximity	*High*	*Signs, training, procedures*	*Medium*	*Yes*
	Cause 2: LEL Concentration	*Medium*	*LEL meter, permits, procedure*	*Medium*	
	Cause 3: Ignition Source	*Low*		*Low*	
Maintenance—open process	Cause 1: Worker Proximity	*High*	*Procedures and training*	*Medium*	*Yes*
	Cause 2: LEL Concentration	*High*	*LEL meter, permits, procedure, ventilation*	*Medium*	
	Cause 3: Ignition Source	*Low*		*Low*	
Maintenance—pigging operations	Cause 1: Worker Proximity	*High*	*Procedures and training*	*Medium*	*Yes*
	Cause 2: LEL Concentration	*High*	*LEL meter, permits, procedure, training*	*Medium*	
	Cause 3: Ignition Source	*Low*		*Low*	
Maintenance—Startup *Loss of Containment must be considered*	Cause 1: Worker Proximity	*High*	*Procedures and training*	*Medium*	*Yes*
	Cause 2: LEL Concentration	*High*	*LEL meter, permits, procedure*	*Medium*	
	Cause 3: Ignition Source	*Low*		*Low*	
Maintenance—purge/blowdown	Cause 1: Worker Proximity	*High*	*Procedures and training*	*Medium*	*Yes*
	Cause 2: LEL Concentration	*High*	*LEL meter, permits, procedure, ventilation*	*Medium*	
	Cause 3: Ignition Source	*Low*		*Low*	

Figure E.4—Example Gas Processing/Midstream Flash Fire Risk Assessment Worksheet

Operation, Location, Company:____________________

Persons Performing Risk Assessment:____________________

Conditions of Well Site (oil/gas/water well, oil/water based mud, SIMOPS, other conditions affecting flash fire potential).____________________

Operations: *Completions* Date:__________

Task or Area (Partial List)		Initial Risk Level Low/Med/Hi	Prevention Barriers (Engineering/Administrative Controls)	Final Risk Level After Barriers	FRC Needed?
Move in and rig-up	Cause 1: Worker Proximity	*Low*			*No*
	Cause 2: LEL Concentration	*Low*			
	Cause 3: Ignition Source	*Medium*			
NU BOP, pressure test BOP and casing	Cause 1: Worker Proximity	*Low*			*No*
	Cause 2: LEL Concentration	*Low*			
	Cause 3: Ignition Source	*Medium*			
Cleanout wellbore	Cause 1: Worker Proximity	*Medium*			*Yes*
	Cause 2: LEL Concentration	*Medium*			
	Cause 3: Ignition Source	*Medium*			
Fracture/ stimulate	Cause 1: Worker Proximity	*Medium*			*Yes*
	Cause 2: LEL Concentration	*Medium*	*Can't mitigate all risk of diesel spray leak*		
	Cause 3: Ignition Source	*High*			
Run production tubing	Cause 1: Worker Proximity	*Medium*			*Yes*
	Cause 2: LEL Concentration	*Medium*			
	Cause 3: Ignition Source	*Medium*			
ND BOP, NU and test tree	Cause 1: Worker Proximity	*Medium*			*Yes*
	Cause 2: LEL Concentration	*Medium*			
	Cause 3: Ignition Source	*Medium*			
Rig down and move out	Cause 1: Worker Proximity	*High*	*Verify control of fuel sources*	*Low*	*No*
	Cause 2: LEL Concentration	*Medium*	*Personal or stationary LEL monitors*	*Low*	
	Cause 3: Ignition Source	*Medium*			
Flowback, shut-in well	Cause 1: Worker Proximity	*High*		*High*	*Yes*
	Cause 2: LEL Concentration	*High*	*Use LEL monitors*	*Medium*	
	Cause 3: Ignition Source	*High*	*Limit access to running engines*	*Medium*	

Figure E.5—Example Completions Flash Fire Risk Assessment Worksheet

Operation, Location, Company:____________________

Persons Performing Risk Assessment:____________________

Conditions of Well Site (oil/gas/water well, oil/water based mud, SIMOPS, other conditions affecting flash fire potential).____________________

Operations: *Production operations* Date:__________

Task or Area (Partial List)		Initial Risk Level Low/Med/Hi	Prevention Barriers (Engineering/Administrative Controls)	Final Risk Level After Barriers	FRC Needed?
Class 1 Div. 1 (List) *thief hatch, maintenance on PSV*	Cause 1: Worker Proximity	*High*	*Signs, training, procedures (site & task specific)*	*Medium or Low*	*Yes; No if proximity risk is low*
	Cause 2: LEL Concentration	*High*	*LEL meter, permits, procedure*	*Medium or Low*	
	Cause 3: Ignition Source	*Low*	*Facility design, procedures*	*Low*	
Class 1 Div. 2 (List)	Cause 1: Worker Proximity	*High*	*Signs, training, procedures*	*Medium*	*No*
	Cause 2: LEL Concentration	*Medium*	*LEL meter, permits, procedure*	*Low*	
	Cause 3: Ignition Source	*Low*		*Low*	
Combustibles in vicinity	Cause 1: Worker Proximity	*High*			*No*
	Cause 2: LEL Concentration	*Low*			
	Cause 3: Ignition Source	*Low*			
Hot work—no permit/under permit	Cause 1: Worker Proximity	*High*			*No*
	Cause 2: LEL Concentration	*Low*	*LEL meter, permit, procedures, training*	*Low*	
	Cause 3: Ignition Source	*High*	*Permit, procedures, training*	*Low*	
Maintenance and plant upgrades	Cause 1: Worker Proximity	*High*			*Must be site-specific evaluation*
	Cause 2: LEL Concentration	*High*	*LEL meter, permit, procedures, training*	*Low*	
	Cause 3: Ignition Source	*Medium*	*Hot Work Permit, training*	*Low*	
New construction (no process materials introduced)	Cause 1: Worker Proximity	*High*			*No*
	Cause 2: LEL Concentration	*Low*			
	Cause 3: Ignition Source	*Medium*			
Fired vessel operations	Cause 1: Worker Proximity	*High*	*Use remote starting unit or long handled lighter*	*High*	*Yes*
	Cause 2: LEL Concentration	*High*	*LEL meter*	*High*	
	Cause 3: Ignition Source	*High*		*High*	
Hot oil operations	Cause 1: Worker Proximity	*High*		*High*	*Yes*
	Cause 2: LEL Concentration	*High*	*LEL meter*	*High*	
	Cause 3: Ignition Source	*High*		*High*	

Figure E.6—Example Production Operations Flash Fire Risk Assessment Worksheet

Operation, Location, Company:______________________

Persons Performing Risk Assessment:______________________

Conditions of Well Site (oil/gas/water well, oil/water based mud, SIMOPS, other conditions affecting flash fire potential). Oil/gas well, tight shale, no hydrocarbon bearing zones expected short of TD

Operations: Drilling tight shale well Date:__________

Task or Area (Partial List)		Initial Risk Level Low/Med/Hi	Prevention Barriers (Engineering/Administrative Controls)	Final Risk Level After Barriers	FRC Needed?
Location construction	Cause 1: Worker Proximity	Low			No
	Cause 2: LEL Concentration	Low			
	Cause 3: Ignition Source	Low			
Move rig to location	Cause 1: Worker Proximity	Low			No
	Cause 2: LEL Concentration	Low			
	Cause 3: Ignition Source	Med/High	Manage traffic, proper flammable storage		
Rig up	Cause 1: Worker Proximity	Low			No
	Cause 2: LEL Concentration	Low			
	Cause 3: Ignition Source	Medium			
Drill surface hole	Cause 1: Worker Proximity	Low			No
	Cause 2: LEL Concentration	Low			
	Cause 3: Ignition Source	Medium			
Run surface casing and cement	Cause 1: Worker Proximity	Low			No
	Cause 2: LEL Concentration	Low			
	Cause 3: Ignition Source	Medium			
Drill through gas/oil zone	Cause 1: Worker Proximity	High	No visitors allowed on rig floor while drilling through the zone		No
	Cause 2: LEL Concentration	Medium	Manage mud, circulate to gas buster, LEL meter on floor	Low	
	Cause 3: Ignition Source	Medium			
Run production Casing	Cause 1: Worker Proximity	High	No visitors allowed on rig floor while drilling through the zone		No
	Cause 2: LEL Concentration	Medium	Manage mud, circulate to gas buster, LEL meter on floor	Low	
	Cause 3: Ignition Source	Medium			
Rig down and move out	Cause 1: Worker Proximity	High			No
	Cause 2: LEL Concentration	Low			
	Cause 3: Ignition Source	Medium			

Figure E.7—Example Drilling Flash Fire Risk Assessment Worksheet with Special Conditions

Annex F
(informative)

FRC Use Decision Tree

The FRC Use Decision Tree is designed to be used in determining when FRC should be worn by utilizing a flow charting method. When using a flow chart, the user works through a series of decision boxes to determine the FRC needs based on knowledge of the operation and the hazard. This method minimizes the amount of time that is required to perform a hazard assessment; however, it can increase the activities covered by the use of FRC since it reduces the amount of information needed to make the decision.

Figure F.1 is not an all-inclusive chart; however, it can provide a determination on some of the common areas of potential flash fire. In this example, the flow chart was built to draw a distinction between a Greenfield site and locations where previous oil and gas production had occurred. A Greenfield site is where oil and gas has not been brought to the surface from the formation, or delivered via pipeline, flow line, or processing equipment.

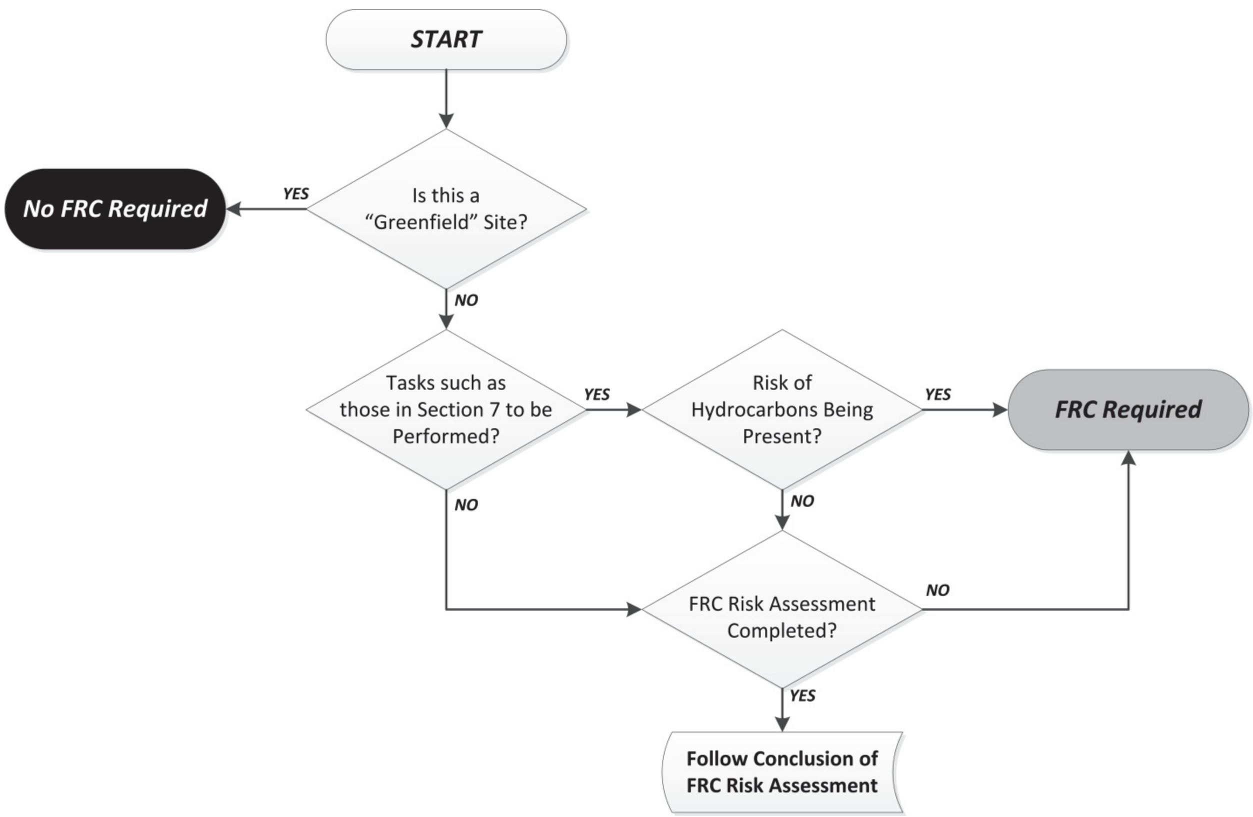


Figure F.1—FRC Use Decision Tree Flow Chart

Bibliography

[1] API Recommended Practice 500, *Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2*

[2] ASTM F1506 [1], *Standard Performance Specification for Flame Resistant Textile Materials for Wearing Apparel for Use by Electrical Workers Exposed to Momentary Electric Arc and Related Thermal Hazards*

[3] ASTM F1930, *Standard Test Method for Evaluation of Flame Resistant Clothing for Protection Against Fire Simulations Using an Instrumented Manikin*

[4] CAN/CGSB 155.20-2000 [2], *Workwear for Protection Against Hydrocarbon Flash Fire*

[5] CMA *Manager's Guide to Assessing Flame Resistant Clothing Use*

[6] CAPP *Guide for the Selection and Use of Flame Resistant Workwear*

[7] NFPA 704 [3], *Standard System for the Identification of the Hazards of Materials for Emergency Response*

[8] NFPA 70E, *Standard for Electrical Safety in the Workplace*

[9] NFPA 70, *National Electric Code*

[10] NFPA 2112, *Standard on Flame-Resistant Garments for Protection of Industrial Personnel against Flash Fire*

[11] NFPA 2113, *Standard on Selection, Care, Use, and Maintenance of Flame-Resistant Garments for Protection of Industrial Personnel Against Flash Fire*

[12] ISO 11612 [4], *Protective clothing—Clothing to protect against heat and flame*

[13] ISO 11611, *Protective clothing for use in welding and allied processes*

[14] ISO 14116, *Protective clothing—Protection against heat and flame—Limited flame spread materials, material assemblies and clothing*

[15] JOIFF [5] *Handbook on Personal Protective Equipment (PPE) to Protect Against Heat and Flame*

[16] HSE RR 883 [6], *Vulnerability of oil contaminated fire retardant overalls*

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1 ASTM International, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428, www.astm.org.

2 Canadian General Standards Board, 11 Laurier Street, Phase III, Place du Portage, Gatineau, Quebec K1A 0S5, Canada, www.tpsgc-pwgsc.gc.ca/ongc-cgsb/index-eng.html.

3 National Fire Protection Association, 1 Batterymarch Park, Quincy, Massachusetts 02169-7471, www.nfpa.org.

4 International Organization for Standardization, 1, ch. de la Voie-Creuse, Case postale 56, CH-1211 Geneva 20, Switzerland, www.iso.org.

5 International Organization for Industrial Hazard Management, Fulcrum Consultants, P.O. Box 10346, Dublin 14, Ireland, www.joiff.com.

6 Health and Safety Executive, Redgrave Court, Merton Road, Bootle, Merseyside L20 7HS, UK, www.hse.gov.uk.

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