Appendix G: Well Control Emergency Management

Well Control Emergency Management Document Below:

WELL CONTROL EMERGENCY MANAGEMENT PLAN

Marathon Oil Corporation

June 9, 2011

Wild Well Control

TABLE OF CONTENTS

INTRODUCTION

PURPOSE

This Well Control Emergency Management Plan (WCEMP) is intended to supplement existing operations' Emergency Management Plans. Local Emergency Management Plans include all spill and emergency response guidelines and contacts, as well as Company-specific Incident Command System roles, responsibilities, and guidance, for responding to hazards and emergencies in each operating area. Local Emergency Management Plans are available in each operation's area office through the Health Environment Safety and Security (HES&S) department.

Procedures for handling emergencies are absolutely essential to ensure the protection of life, property, and the environment. Wild Well Control, Inc.'s (WWCI) Engineering Division has developed this WCEMP for the Company.

The equipment and procedures specified in this WCEMP address various well control incidents ranging from routine well control operations to incidents involving a total loss of well control necessitating the immediate mobilization of intervention equipment and personnel. This WCEMP is system-wide in nature and is intended for use in any operational area.

This document addresses drilling, workover, and production operations, and it assumes that adequate Oil Spill Response Plans are in place.

The primary objective of the WCEMP is to establish a process for responding to and safely managing well control emergencies.

OBJECTIVES

The primary objective of the WCEMP is to establish a process for responding to and safely managing well control emergencies using a standard, uniform approach. This process includes the following responsibilities:

1. Protect the personnel at the site in case of a well control emergency.

2. Define the notification protocols and methods.

3. Prevent further environmental or facility damage or personnel injury while adequate equipment and personnel are being mobilized.

4. Define the critical information that is required in order to determine the appropriate response level and strategies.

5. Organize personnel and provide guidelines for their role in the emergency response and subsequent management.

6. Preselect sources and develop mobilization plans for personnel, equipment, material, and services typically required for implementation of well control procedures.

7. Normalize the incident and bring it under control.

The WCEMP is not intended to replace sound judgment. Modification of the mobilization plan and intervention strategy might be necessary depending on the circumstances of the incident.

Well control incidents require common sense and professional judgment on the part of the person or persons in charge of operations, and no operation should be undertaken if it involves unreasonable risk to personnel.

Information is essential to implement an effective well control incident management system. Recommendations are included for the information to be gathered both at the well site and from office records.

WELL CONTROL EMERGENCY MANAGEMENT PLAN POLICY STATEMENT

The Company is committed to continual readiness of the WCEMP processes, thereby promoting safety as well as the protection of environmental and Company assets during well control emergencies. Commitment to this policy is demonstrated by the signature of the Source Control Unit Leader:

Full and complete support is expected by all employees, contractors, and vendors. The WCEMP Policy is composed of several foundational principles operating together to facilitate a coordinated and effective response to well control emergencies.

PREPAREDNESS

- Develop plans to provide guidance and direction.
- Provide clear assignment of roles and responsibilities.

COMMUNICATIONS

- Provide concise communication of references and lists.
- Inform workforce through training and communication.

RESOURCE MANAGEMENT

- Provide descriptions of possible required resources and equipment.
- Document location and availability of equipment and resources.

COMMAND AND MANAGEMENT

- Define the Incident Command Structure (ICS).
- Ensure full and effective participation and deployment.

ONGOING MANAGEMENT AND MAINTENANCE

- Provide revision control maintaining accuracy and reliability.

WCEMP STRUCTURE

The Well Control Emergency Response Plan (WCEMP) provides an integrated and systematic approach to well control incident management. This system provides the policies and procedures that are designed to provide guidance to the Company employees, contractors, and other persons in the case of a well control emergency.

DOCUMENTATION STRUCTURE

The structure of the WCEMP is generally aligned with integrated elements of major international standards such as National Incident Management System (NIMS), American Petroleum Institute (API), International Organization for Standardization (ISO), Occupational Health and Safety Advisory Services (OHSAS), and others. This helps to ensure that the WCEMP comprehensively addresses each of the well control emergency elements systematically and completely.

INCIDENT COMMAND STRUCTURE

The NIMS of the Federal Emergency Management Agency (FEMA) is a systematic approach for preventing and reacting to emergency situations. Within the system, the ICS is a standard method for organizing and naming the job positions that would be required in the case of an incident. This provided a well-developed organizational structure, which is crucial to an effective emergency response.

This WCEMP uses an ICS that has been developed specifically for responding to well control emergencies. The organizational structure for the management of well control emergencies is called the Emergency Response Organization, which comprises the Well Control Emergency Response Team (WCERT) and the On-Site Response Team (ORT), all reporting to the Incident Commander. This WCEMP covers the duties and responsibilities of the ORT.

COMMAND AND MANAGEMENT

The WCEMP provides effective and efficient incident management and coordination. This is accomplished by providing a standardized response structure that coordinates on-site and off-site management structures along with vital well control expertise provided by contractors.

Preparedness

This WCEMP provides the framework to help manage well control incidents. Every emergency is different, but being prepared with a comprehensive and systematic approach, and working in conjunction with appropriate well control expertise, provides the best opportunity for an optimum and favorable outcome.

Communications and Information Management

The roles and responsibilities for key well control response personnel are clearly defined. Specific and accurate contact information is consolidated and made accessible to well control personnel and other stakeholders. Information management includes processes ranging from the collection and formatting of information prior to the incident via the use of forms and data sheets. This is done to capture and preserve information that develops during the course of the incident, as well as postincident evaluation, leading to system and process enhancement.

Resource Management

Resource management is a vital need during the entire well control incident. The WCEMP provides equipment listings that help maximize the effectiveness of well control efforts.

Ongoing Management and Maintenance

Ongoing management and maintenance of the WCEMP is critical to its utility as an effective tool to help mitigate well control incidents. It must be kept current to the project's needs. A Management of Change (MOC) process should be used to ensure that any changes to the WCEMP, due to a change of contact data, well or site information, or other items, as well as any adjustments that might be generated from a periodic or annual review, are reflected in an accurate and timely fashion.

The Person in Charge (PIC) for each work site should review the content of the WCEMP and determine which of the required plans, programs, and procedures listed in this manual are applicable to their operation.

This review should be conducted at least once each year or when the WCEMP is updated, whichever is more frequent. An optional WCEMP review meeting is described and documented to help ensure that the plan is kept current to ongoing project and operational conditions as well as to incorporate any additional lessons learned on this or other projects that could enhance the effectiveness or utility of the WCEMP.

ON-SITE RESPONSE TEAM ORGANIZATION CHART

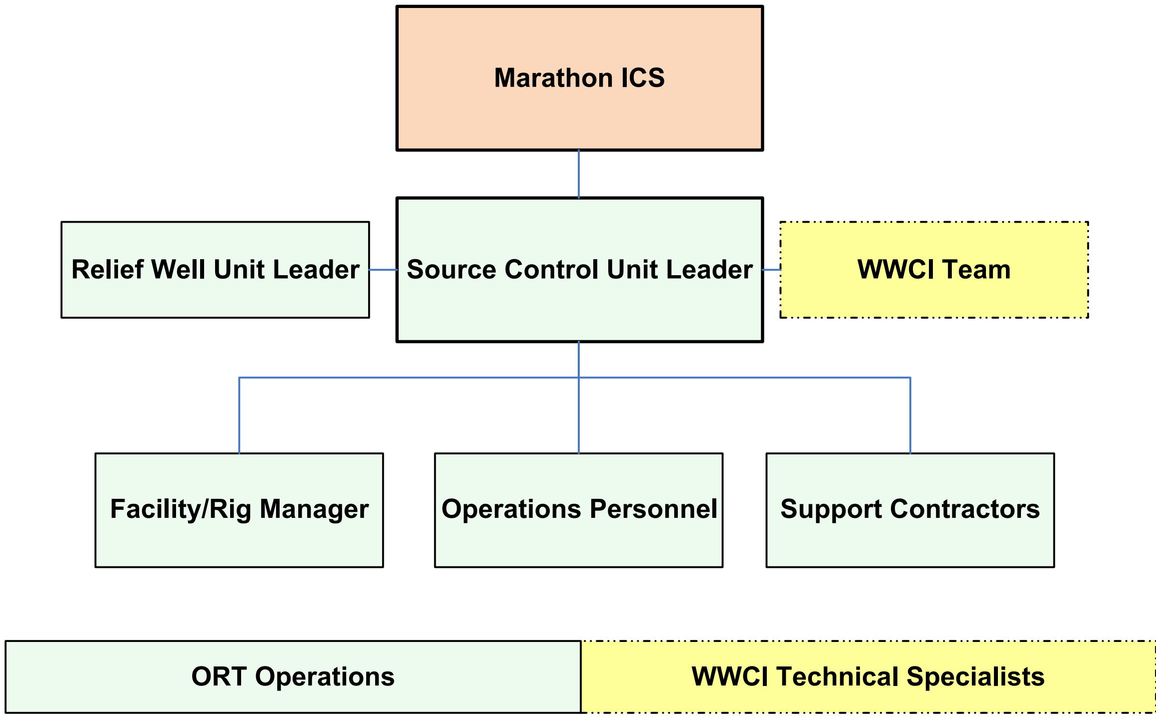

Figure 3.1 – On-Site Response Team Organization Chart

On-Site Response Team

The ORT comprises Company and contract personnel on a 24-hour callout who have the experience to deal with well-control-related emergencies. It will also have additional vendor support personnel to assist in the emergency.

The ORT will be managed by the Source Control Unit Leader, who will direct the actions of the team. The ORT will be responsible for on-site activities.

Primary Objectives of the ORT

1. Have specific members of the staff immediately available in the event of an incident.
2. Help plan and implement the well intervention.

Primary Duties of the ORT

1. Secure the incident site and determine status of all personnel.
2. Provide medical assistance as required.
3. Make initial assessment of emergency situation.
4. Provide notification to the Company and WCERT.
5. Mobilize locally available equipment and services.
6. Determine equipment and services required for operations and safety.
7. Establish on-site operations, communications, and medical facilities.
8. Provide regular updates to the Company and WCERT member section chiefs.
9. Establish project work files and implement document control/record-keeping procedures.
10. Establish and implement the well intervention plan.
11. Maintain documentation.

RELIEF WELL TEAM – PERSONNEL ORGANIZATION

The relief well planning and implementation team comprises personnel from various disciplines within the Operator's organization, the directional drilling contractor, the drilling rig contractor, Vector Magnetics, WWCI, and other contractor personnel as required.

The organizational diagram for the planning team is shown in the following figure.

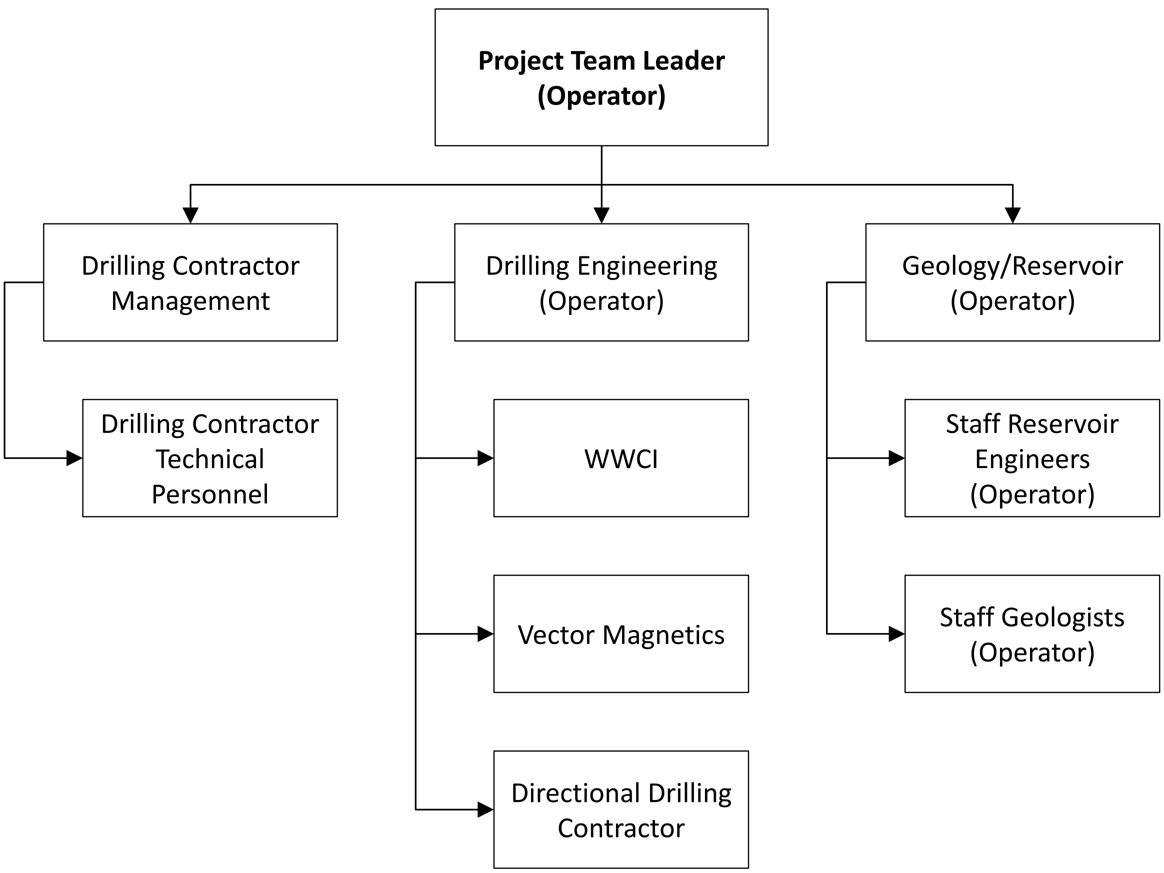

Figure 3.2 – Relief Well Planning Team Organizational Chart

RELIEF WELL TEAM – PROJECT ORGANIZATION (PLANNING PHASE)

The planning phase of the project will be divided into four interrelated groups:

1. Directional Drilling and Intercept
2. Drilling Engineering/Planning
3. Kill/Plug and Abandon (P&A) Operations
4. Hazard Assessment

Personnel from the planning team as well as outside contractors and specialists will be asked to work on various groups associated with the planning phase. The tasks associated with each group are discussed in the following sections.

DIRECTIONAL DRILLING AND INTERCEPT TASKS

The goals of the Directional Drilling and Intercept Group are listed in the following paragraphs without regard to priority or importance.

Surface Location

A preliminary surface location will be chosen based on drilling trajectory, intercept, and safety issues (such as gas dispersion and radiant heat). WWCI will review the proposed surface location in terms of safety. WWCI, along with Vector Magnetics, will review the proposed surface location in terms of the required directional drilling trajectory and approach angle. A memo will be issued listing the results of the review.

The plan survey will resolve the relative distance and direction between the blowout well and relief well surface locations. Uncertainty should be reduced to below 1 m and several (redundant) surveys should be planned. Gross errors in the relative position between the two surface locations cannot be tolerated.

Trajectory

Preliminary trajectories will be developed by the Directional Drilling Contractor. WWCI and Vector Magnetics will review the proposed trajectories in terms of initial search depth, intercept angle, proximity logging program, and so on. A memo will be issued listing the findings and recommended modifications, if any, that result from the review.

Drilling Tools

Determine the most appropriate directional drilling assemblies, measurements while drilling/logging while drilling (MWD/LWD), near-bit inclination/azimuth tools, surveying tools, and procedures. Issue a memo stating recommendations and provide supporting logic.

Intercept Method

Determine the most appropriate method of intercepting the blowout wellbore. Consider kill/plugging operations.

Plan all required tools to accomplish the intercept, including mills and deep-penetrating/oriented tubing conveyed perforator (TCP) guns.

Determine relative position of last casing seat if a direct intercept is to be made. Plan to minimize the open-hole section between the last casing seat and the intercept point, within safe limits. Evaluate whether LWD or other methods are required to identify formation tops for casing-seat placement near the intercept. Issue a memo describing proposed intercept method, specialized tool requirements, and supporting logic.

Intercept Point

Determine the most appropriate depth for the intercept in order to accomplish the relief well goals.

Evaluate the nature (competency) of the formation at the proposed intercept point and the potential for fluid loss, sloughing, or hole collapse. Issue memo specifying intercept depth and provide supporting logic.

If direct intercept/reentry is required, evaluate bulk density and hardness of formations (rate-of-penetration log) near intercept point for best possible side-loading resistance.

Survey Uncertainty

Develop a model of the position uncertainty for the blowout well and the relief well. These uncertainty models will be used to review the proposed directional trajectory and, especially, the initial search depth.

DRILLING ENGINEERING/PLANNING TASKS

The goals of the Drilling Engineering/Planning Group are listed in the following paragraphs without regard to priority or importance.

Casing Design (Tubulars)

Develop the most appropriate casing tubular design to meet the requirements of the relief well. Evaluate burst, collapse, tensile, and triaxial stresses. Recommend appropriate size, connection, weight, and grade of casing. Consider the additional stresses imposed by pumping ambient temperature fluids, in case a high-rate kill becomes necessary (rates and pressures will be provided by WWCI after kill modeling).

Consider the potential for abnormal charging as identified by the Hazard Assessment Group. Develop recommendations and contingencies as required. Evaluate the need for additional casing string to combat potential hole problems or abnormal charging.

Issue memo detailing tubular design, with safety factors and contingencies stipulated.

Casing Design (Seat Selection)

Develop the most appropriate casing seat design based on pore pressure, fracture gradient, and mechanical properties of the casing.

Consider the potential for abnormal charging as identified by the Hazard Assessment Group. Develop recommendations and contingencies as required. Evaluate the need for additional casing string to combat potential hole problems or abnormal charging.

Issue a memo detailing casing seat design, with kick margins and trip margins stipulated.

Cementing Recommendations

Develop the most appropriate cement jobs for all casing strings. Consider thermal stresses that might be imposed by high-rate ambient temperature fluid injection.

Evaluate casing cement jobs in view of possible second intercept and sidetrack (window or section milling).

Issue memo detailing cement design recommendations and design factors.

Mud Program

Develop the most appropriate mud program for each hole section. Consider all normal design factors. Recommend adequate inventories of mud chemicals and weighting material. Recommend appropriate and adequate volumes of lost-circulation material (LCM) for drilling phase and intercept/P&A operations.

Mud Logging

Recommend appropriate mud-logging program and vendor.

Rig Selection

Locate and contract suitable rig for the relief well operations. Base initial criteria on conventional drilling-related parameters. WWCI will make an assessment of all candidate rigs to determine suitability in terms of well control systems and other aspects related directly to the relief well and kill operations.

Consideration should be given to whether the drilling contractor will require additional insurance coverage for the relief well operations (sometimes required for such operations).

KILL/P&A OPERATIONS TASKS

The goals of the Kill/P&A Operations Group are listed in the following paragraphs without regard to priority or importance.

Kill Modeling

WWCI will perform multiphase dynamic kill modeling (using the Dyn-X® computer model) to define the pump rates, expected friction pressures, and hydraulic horsepower (HHP) requirements for various kill scenarios.

A memo will be issued detailing the findings of the dynamic kill modeling, including basis of design, scenario descriptions, and HHP requirements, with recommended redundancies.

Contingencies

Various scenarios will be developed so that adequate hazard mitigation and operational practices can be developed to ensure the reliability of the relief well drilling and kill operations. Scenarios might include limited injection capabilities, disruption of annular bridges, or premature intercept.

A memo will be issued detailing the results of the scenario planning efforts. The memo will contain discussions of the probabilities, consequences, and mitigating measures associated with each reasonable scenario.

Diagnostics

An investigation will be conducted to determine whether diagnostic procedures such as noise/temperature logs, thermal decay time (TDT) logs, pumping, or pressure testing are feasible or warranted based on the particular incident.

These kinds of diagnostic measures are sometimes warranted to evaluate or ensure the adequacy of the kill or plugging operations.

A memo will be issued discussing the various aspects, applicability, and need for such diagnostic measures. For those measures that are recommended, a discussion of the equipment and services required, as well as the impact on relief well planning and implementation, will be included.

Kill Equipment

The equipment, material, and services required to undertake all kill operations (including contingency operations) will be stipulated. A memo will be issued describing the required HHP, fluid volumes, specialized tools, low-pressure fluid transfer, pump lines, and blowout preventer (BOP) stack modifications for the kill operations.

P&A Planning

Both the blowout well and the relief well will require proper plugging and abandonment after the kill operations. The relief well might be used as a replacement well after kill and plugging operations have been concluded.

A memo will be issued detailing the equipment, services, and procedures required for proper plugging and abandonment of the two wells.

Hazard Assessment Tasks

The goals of the Hazard Assessment Group are listed in the following paragraphs without regard to priority or importance.

Shallow Seismic

A determination will be made as to whether additional seismic work is required in order to define the boundaries of shallow gas accumulations. This determination will be based on the circumstances of the blowout and the potential for charging of shallow, porous zones. A memo will be issued with recommendations as to whether further investigation is warranted. If so, the memo will include equipment and services required, along with operational procedures to be implemented.

Charging

The potential impact of abnormal charging on relief well design and operations will be investigated based on geological column and blowout circumstances (such as open flow versus bridged).

A memo will be issued discussing the results of the investigation and proposed changes to well design, surface location, or other aspects of the relief well.

Surface Hazards

Surface hazards are generally more applicable to offshore incidents. However, gas accumulations from surface vents, abandoned wellbores, and pipelines, or other hazards to the relief well operations will be evaluated. A memo will be issued discussing any unusual hazards found and proposed methods to mitigate their effects.

Shallow Gas

If shallow charging is confirmed (or absence cannot be confirmed), enhanced shallow gas procedures will be implemented for the top-hole portion of the relief well.

A memo will be issued that defines the equipment and methods proposed for the shallow gas handling procedures.

SimOps

A Simultaneous Operations (SimOps) plan will be developed for operations that should be implemented in order to configure the blowout well for kill operations. This might include additional diversion or monitoring devices.

Relief Well Team – Operational Phase

The operational phase will consist of conventional drilling operations enhanced by the necessary hazard mitigation measures for shallow gas or abnormal charging, and precise directional control based on proximity logging results.

WWCI will provide expert guidance on well-control-related issues, as well as assistance with directional control. This support will consist of a two-man team comprising one Senior Well Control Specialist and one Senior Well Control Engineer stationed at the drill site on a full-time basis. As the relief well nears the intercept point, both WWCI specialists will focus on the intercept and kill-operations planning.

The relief well will be separated into three distinct phases, based on relief well proximity. Each phase will have a defined status for kill equipment and personnel status. Typical phases are described below.

Phase 1 – Spud to Initial Search Depth

Operations:	Drill to a preplanned point in space that positions the relief well sufficiently close to the blowout well magnetic target. Make initial proximity search and plan pass-by for triangulation (if deemed necessary) or approach path.
Kill-Equipment Status:	Not required under normal circumstances.

Phase 2 – Initial Search Depth to Approach

Operations:	Determine the relative position between relief well and blowout well. Directional corrections to follow blowout well to intercept point. Spot-checks with proximity logs to determine relative positions as required.
Kill-Equipment Status:	MIRU and test kill equipment when drilling within 50' 3-D distance. Kill equipment and personnel are to be on standby status. All high-pressure and low-pressure kill pumping equipment is to be pressure- and rate-tested. Coordination and control procedures are to be in place. Personnel assignments and kill procedures, including limiting pressures, contingencies, and other related matters, are to be documented, distributed to all involved parties, and understood.

All kill-related equipment will remain on 24-hour standby (while drilling), capable of implementing kill procedure within 15 minutes of notification. Kill mud should be monitored 24 hours per day, agitated, and kept ready for kill implementation.

PHASE 3 – APPROACH TO INTERCEPT POINT

Operations: Make directional corrections as required to follow blowout well to intercept point. Perform spot checks with proximity logs as required. Make final alignment for setting casing to within 40'–60' of intercept point, or aligned with blowout wellbore within 1 m for perforating operations. Alignment at casing shoe must be appropriate for intercept method.

Set casing and drill out for intercept/kill operations.

Kill-Equipment Status: All kill-related equipment will be running and manned 24 hours per day, unless otherwise instructed. Kill procedure should be implemented without delay upon intercept. All monitoring and supervisory personnel should be on ready status, with a communication system in place; operations and status should be checked every half hour.

WILD WELL CONTROL, INC. EMERGENCY CONTACT LIST

For Well Control Emergencies **CALL: +001.281.784.4700 USA** **Answered 24 Hours/Day by a WWCI Employee**
Check local contact lists to find contact information for additional well control companies.

Wild Well Control, Inc.
2202 Oil Center Court, Houston, TX 77073
Telephone: +001.281.784.4700/Fax: +001.281.784.4750
E-mail: wildwell@wildwell.com, Website: www.wildwell.com

INCIDENT RESPONSE LEVELS

Figure 4.1 is a summary of the incident response levels. These response levels are intended as guidelines and can be used on various types of wells.

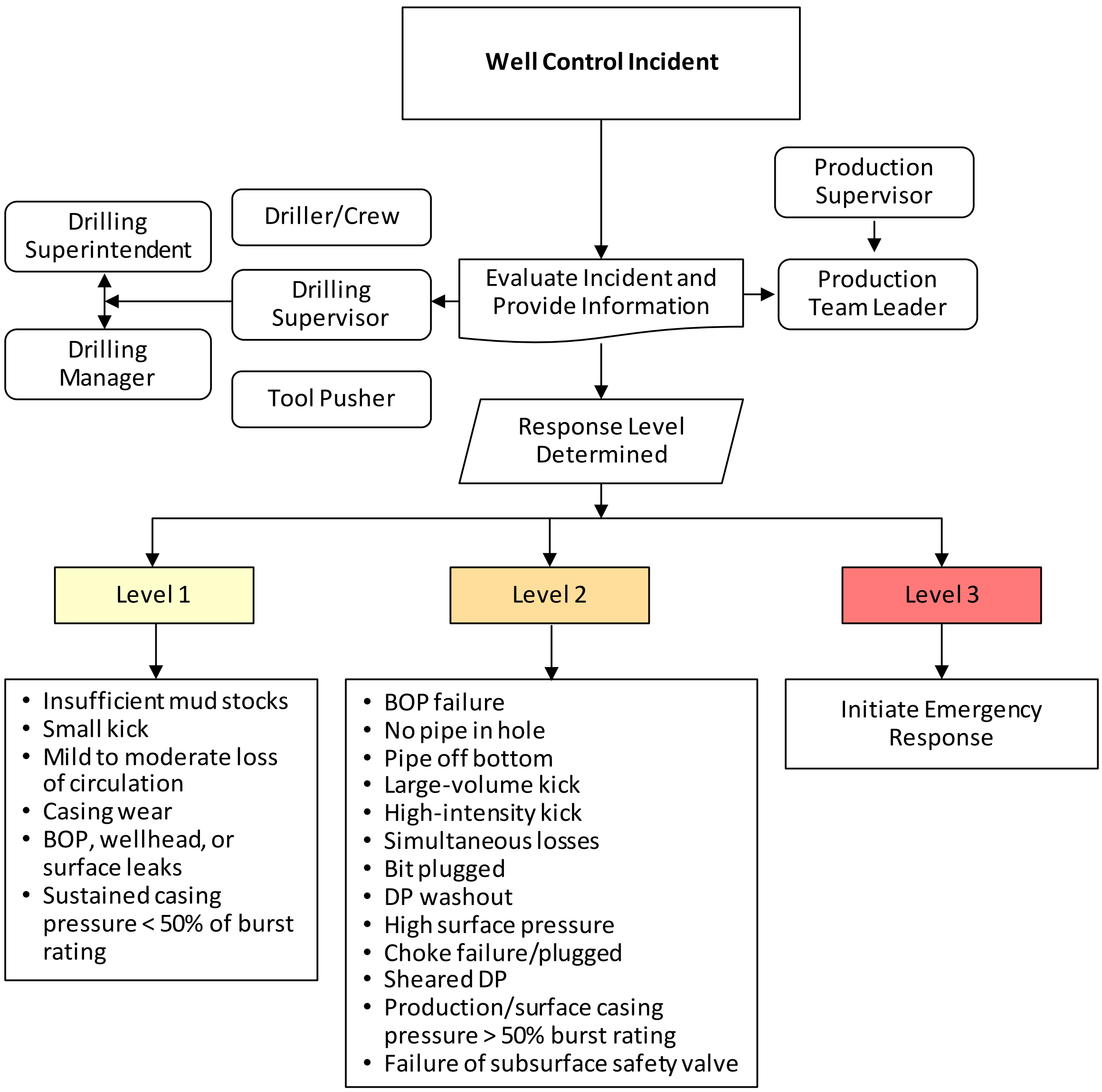

Figure 4.1 – Incident Response Levels

Level 1 Incident

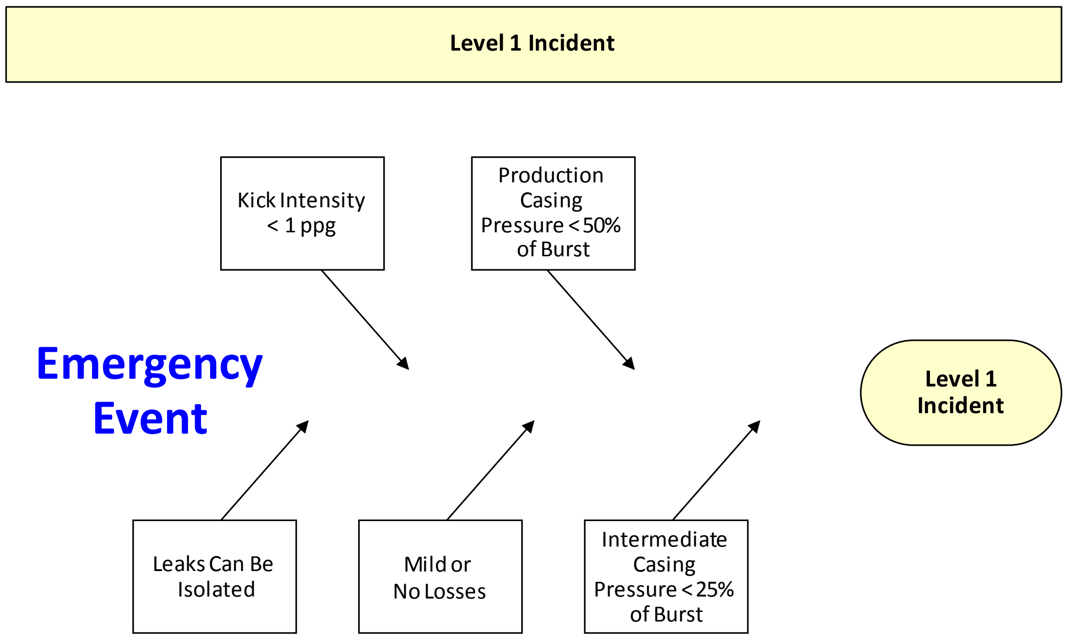

Figure 4.2 – Level 1 Incident

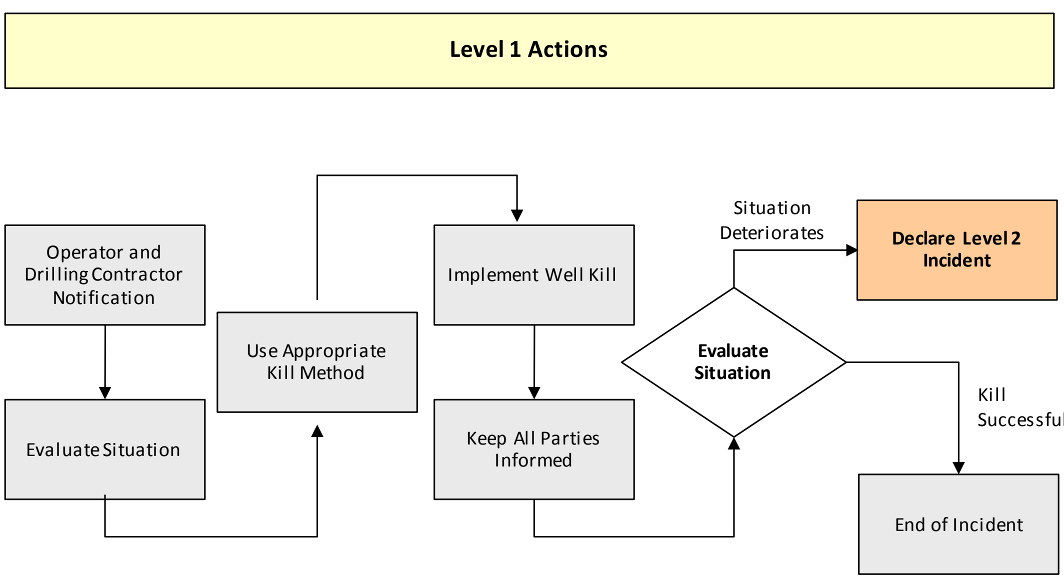

Figure 4.3 – Level 1 Actions

LEVEL 2 INCIDENT

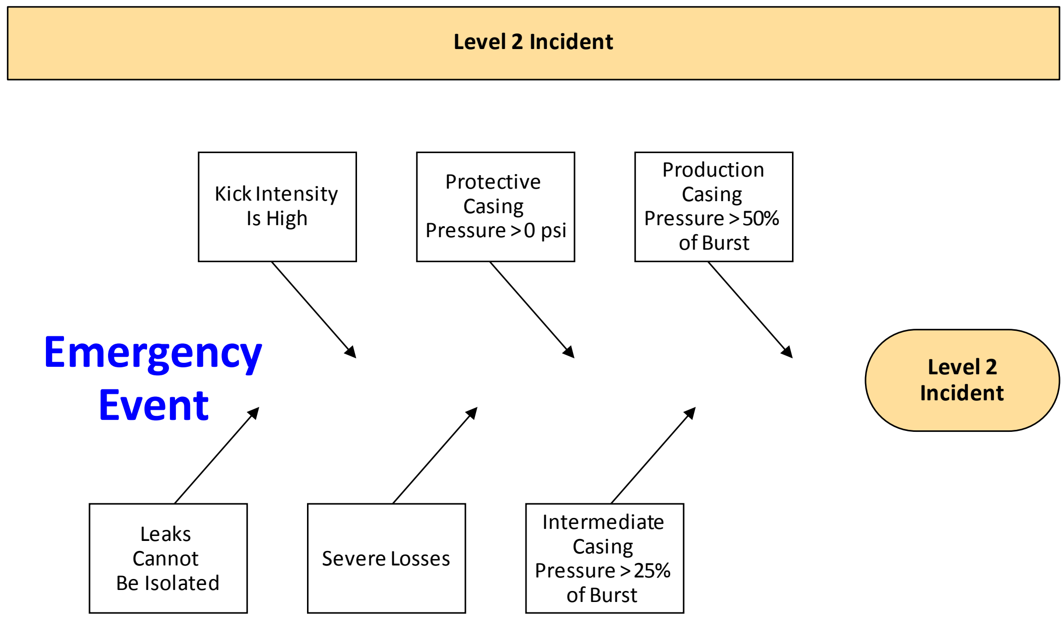

Figure 4.4 – Level 2 Incident

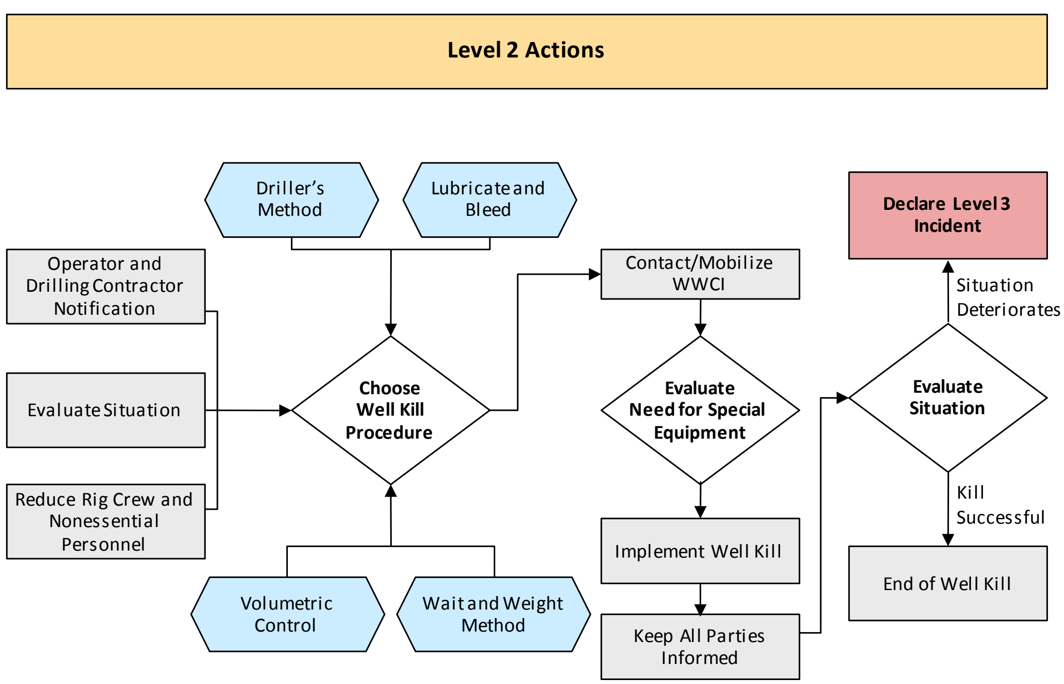

Figure 4.5 – Level 2 Actions

LEVEL 3 INCIDENT

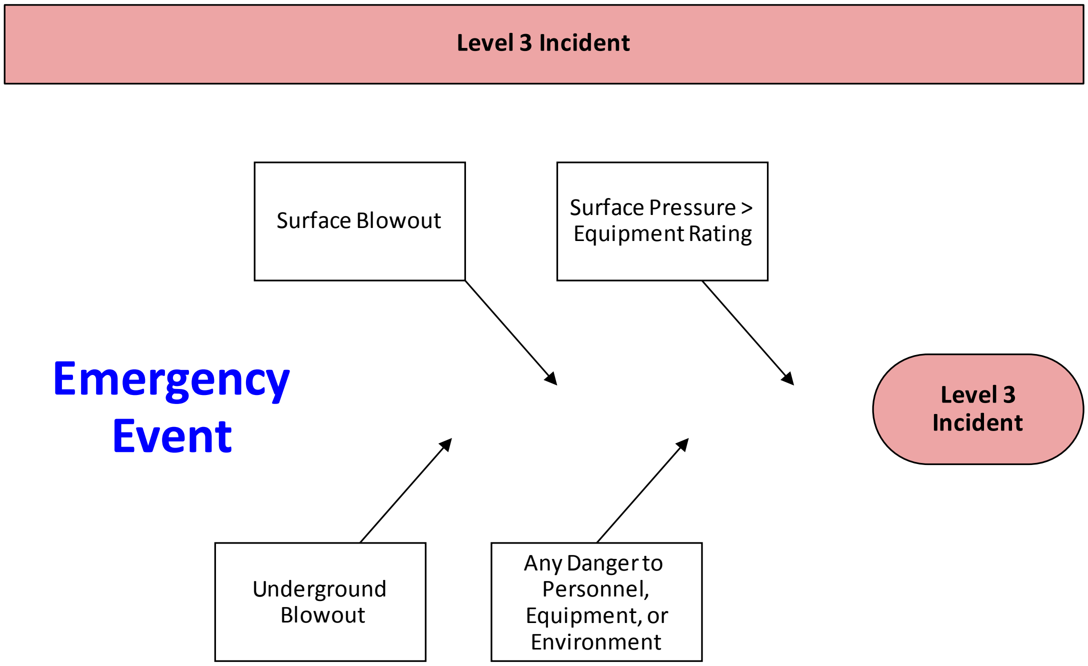

Figure 4.6 – Level 3 Incident

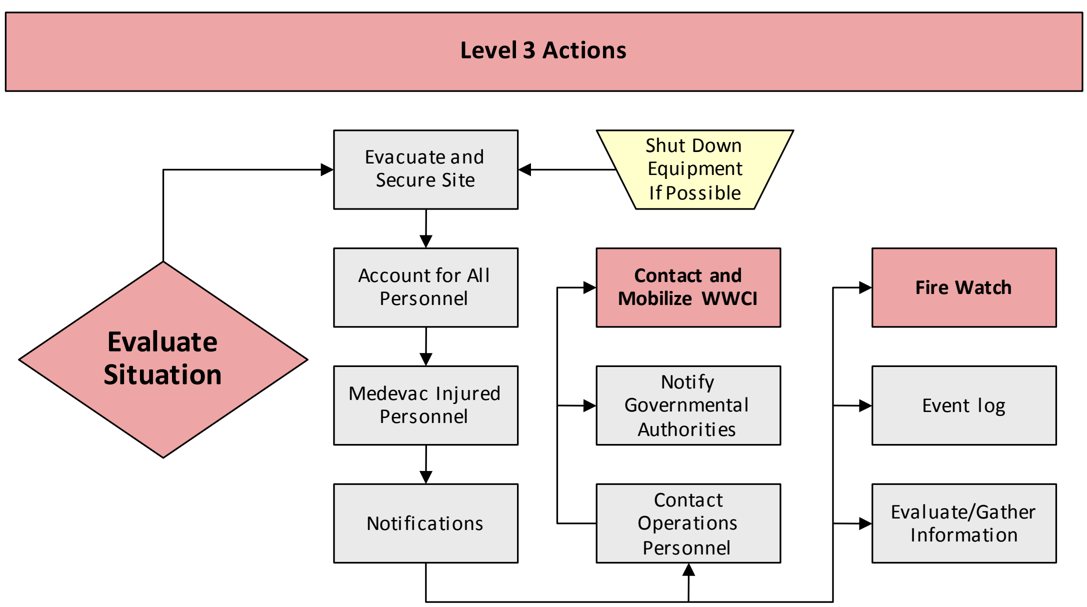

Figure 4.7 – Level 3 Actions

INTERVENTION ACTION PLAN

This section of the WCEMP is intended to detail an action plan for a Level 3 incident (or possibly a Level 2 with significant probability of escalation). Figure 5.1 (Response Process Flowchart) illustrates the major activities recommended for an immediate response (first 12 to 24 hours) and the Interim Actions that will be required to establish on-site operations.

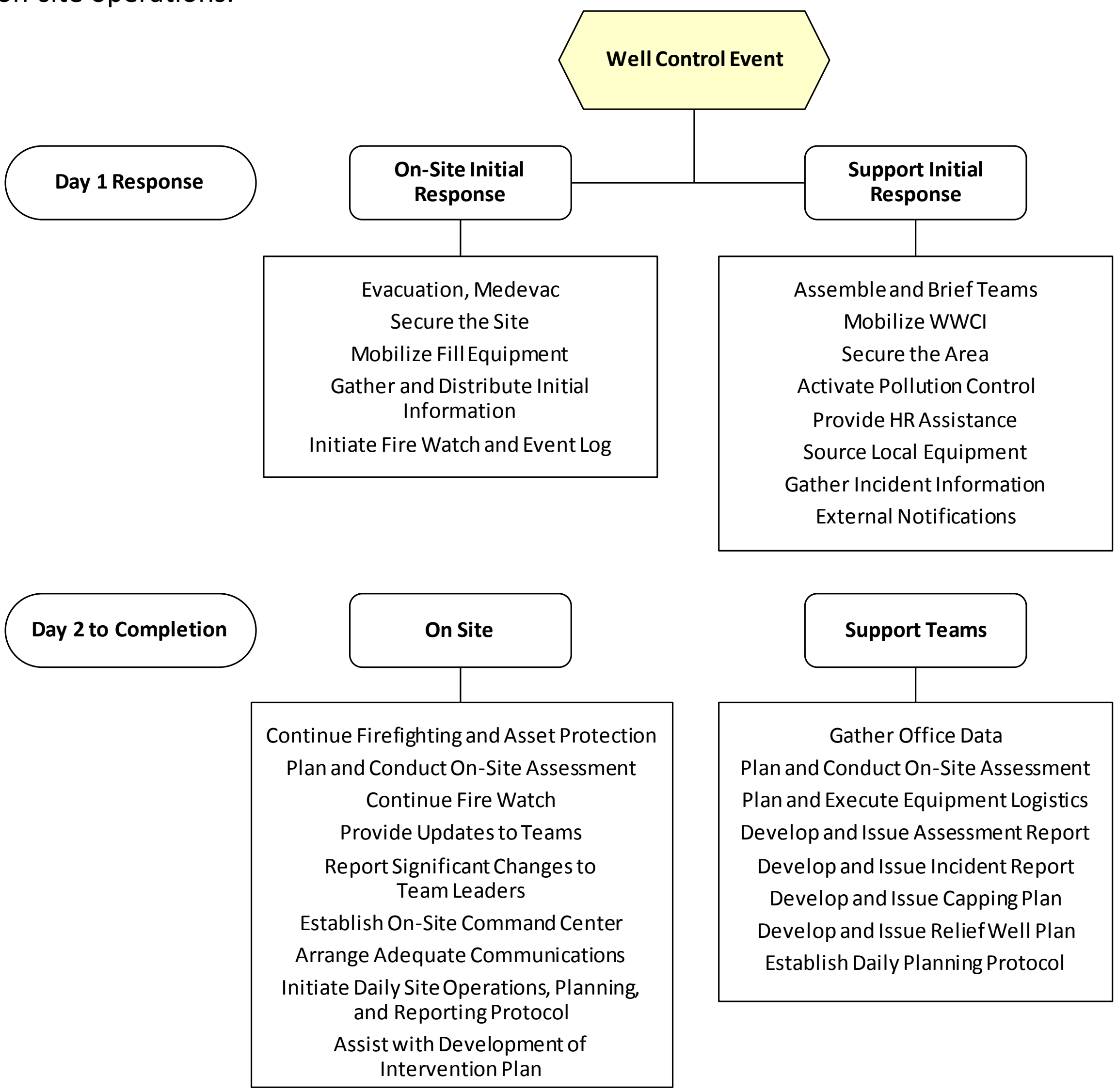

Figure 5.1 – Response Process Flowchart

SOURCE CONTROL UNIT LEADER

Primary:	Rig Foreman/Drilling Contractor
Reports to:	Deputy Incident Commander

GENERAL DUTIES AND RESPONSIBILITIES

1. Coordinate personnel-accounting efforts and evacuation of personnel.
2. Isolate the emergency site and initial notifications.
3. Provide primary assessment.
4. Mobilize locally available equipment and services as required.
5. Gather initial field information.
6. Above all, ensure the safety of on-site personnel during the initial stages of the intervention.
7. Following the initial response, work with the Well Control Operations Team and contractors to plan and implement intervention measures.

SPECIFIC DUTIES

MAKE initial assessment of incident and, if time allows, confer with Deputy Incident Commander and WWCI on remedial measures and appropriate response level.

ORDER evacuation of rig and oversee evacuation procedures. Account for all personnel.

ASSESS the need for medical assistance, Medevac, and search-and-rescue operations. Notify Company and advise of assistance required.

RENDER first aid, as required.

INITIATE any required search-and-rescue efforts that need to be undertaken.

SHUT DOWN fired equipment, if possible.

SECURE site, if possible.

ENSURE that the proper information has been gathered, as follows, so that an adequate response can be formulated:

1. Determine the status of the incident.
2. Determine the number of injuries and need for assistance.
   a. Names of injured personnel and employer
   b. Extent of injuries
   c. Medevac dispatched (if required)
   d. ETA of injured/evacuated personnel to staging area or hospital
3. Ensure that medical care and evacuation are proceeding, and that all personnel are accounted for.

ESTABLISH and supervise the following:

1. Firefighting (FIFI) and asset protection
2. Fire watch and event log
3. Well control operations at the site

PROVIDE frequent updates to Deputy Incident Commander during the WWCI initial mobilization.

COORDINATE with drilling contractor representative, WWCI Team Leader, and Well Control Safety Specialist to ensure all hazards have been properly addressed before initial assessment or intervention measures are implemented.

PROVIDE assistance in support of response and intervention efforts.

1. Establish exclusion or work zones.
2. Assess hazards and implement mitigation measures.
3. Establish On-Site Command Center.

COORDINATE with Well Control Safety Specialist to ensure all necessary personal protective equipment (PPE) has been provided.

PROVIDE cost estimates/commitments to Planning Section Chief for tracking and processing.

CONDUCT daily operations and planning meetings at the site.

INITIATE and maintain accurate documentation of all conversations and actions.

RELIEF WELL UNIT LEADER

Primary:	
Reports to:	Source Control Unit Leader

GENERAL DUTIES AND RESPONSIBILITIES

1. Provide technical assistance to ORT and Operations and Planning Section Chiefs for evaluation, planning, and implementation of a relief well.
2. Coordinate and communicate with the WCERT.

SPECIFIC DUTIES

ASSESS the need for relief well planning and initiate in conjunction with Well Control Team Leader as required.

PROVIDE input into development of the Incident Action Plans for each work period, coordinating with Well Control Team Leader.

ATTEND planning and briefing meetings on a regular basis.

INITIATE and maintain a log of all conversations and actions.

FACILITY/RIG MANAGER

Primary:	Drilling Contractor
Reports to:	Source Control Unit Leader

GENERAL DUTIES AND RESPONSIBILITIES

1. Ensure the health, safety, and welfare of all persons at the installation.
2. Ensure the safety of the installation.
3. Make the initial notifications to installation parent company.
4. Coordinate reports to governmental agencies with the WCERT so there is no miscommunication.
5. Above all, ensure the safety of all on-site personnel during the initial stages of the intervention.
6. Ensure that the Company and governmental safety and environmental regulations are enforced.

SPECIFIC DUTIES

MAKE initial assessment of incident and, if time allows, confer with the Company Man on remedial measures and Response Level.

ORDER evacuation of rig and oversee evacuation procedures. Account for all personnel.

ASSESS the need for medical assistance or Medevac.

RENDER first aid as required.

SHUT DOWN fired equipment, if possible.

SECURE rig, if possible.

ENSURE that the proper information has been gathered, as follows, so that an adequate response can be formulated:

1. Determine the status of the incident.
2. Determine the number and type of injuries and need for additional assistance.
    a. Names of injured personnel and employer
    b. Extent of injuries
    c. Medevac dispatched (if required)
    d. ETA of injured/evacuated personnel to staging area or hospital
3. Ensure that medical care and evacuation are proceeding and that all personnel are accounted for.

ESTABLISH and supervise the following:

1. FIFI and asset protection
2. Fire watch and event log

COORDINATE notification of governmental agencies with the Operator when required by law.

PROVIDE frequent updates to the Company Man and Drilling Contractor Management.

COORDINATE with Source Control Unit Leader, ORT Leaders (Safety and Well Control Operations), and Well Control Engineer to ensure all hazards have been properly addressed before initial assessment or intervention measures are implemented.

PROVIDE assistance in support of response and intervention efforts.

1. Establish exclusion or work zones.
2. Provide hazard assessment and implement mitigation measures.
3. Establish On-Site Command Center.

COORDINATE with Well Control Safety Specialist to ensure all necessary PPE has been provided.

INITIATE and maintain a log of all conversations and actions.

WELL CONTROL SAFETY SPECIALIST

Primary:	WWCI Well Control Safety Specialist
Reports to:	Source Control Unit Leader

GENERAL DUTIES AND RESPONSIBILITIES

1. Advise the WCERT, on-site personnel, and staging area on health and safety.
2. If suitably qualified, the Well Control Safety Specialist will also provide advice on tactical FIFI and rescue procedures.
3. Assess hazards associated with the incident and help ensure the safety of on-site personnel.
4. Develop and implement the Site Safety Plan.
5. Ensure safety issues are documented and addressed.
6. Correct unsafe situations and ensure that Company and governmental regulations are enforced.

SPECIFIC DUTIES

ENSURE all hazards have been properly addressed and that adequate mitigation measures are in place.

ASSIST with safety aspects of initial assessment planning.

COORDINATE with WWCI, Source Control Unit Leader, and Operations Section Chief to ensure all hazards have been properly addressed and that adequate mitigation measures are in place at all times.

PROVIDE assistance in support of response and intervention efforts.

1. Establish exclusion or work zones.
2. Provide hazard assessment and implement mitigation measures.

ENSURE that all necessary PPE has been provided and appropriate medical facilities are on site during the intervention.

DEVELOP, issue, and implement Site Safety Plan.

1. Conduct initial assessment.

2. Oversee continuing intervention operations.

3. Maintain Site Safety Plan and modify as required.

ATTEND daily operations and planning meetings on site.

INITIATE and maintain accurate documentation of all conversations and actions.

OPERATIONS PERSONNEL

Primary:	On-Site Operations Personnel
Reports to:	Source Control Unit Leader

GENERAL DUTIES AND RESPONSIBILITIES

1. Perform well intervention activities as directed by Source Control Unit Leader.
2. Provide expertise and project development as incident requires.
3. Specify equipment and resources as required.
4. Assist in coordination of assessment, planning, resource specifications, and implementation of intervention measures.

SPECIFIC DUTIES

RECEIVE and discuss initial information/incident status with Source Control Unit Leader.

PROVIDE assistance in support of response and intervention efforts.

PERFORM hazard assessment and mitigation measures.

ASSIST in other duties as required or directed.

SUPPORT CONTRACTORS

Primary:	As Designated
Reports to:	Source Control Unit Leader

GENERAL DUTIES AND RESPONSIBILITIES

1. Direct the individual company's activities under the direction of the Source Control Unit Leader.
2. Specify equipment and resources as required.
3. Coordinate assessment, planning, resource specifications, and implementation of intervention measures.

SPECIFIC DUTIES

RECEIVE and discuss initial information and incident status with Source Control Unit Leader.

PROVIDE advice to Source Control Unit Leader upon initial contact regarding the following:

- Initial equipment requirements
- Initial personnel requirements

ARRANGE personnel mobilization and advise Source Control Unit Leader of itinerary and ETAs.

COORDINATE with Well Control Safety Specialist, Source Control Unit Leader, and Well Control Team Leader to ensure all hazards have been properly addressed before any intervention measures are implemented.

PROVIDE assistance in support of response and intervention efforts. Provide hazard assessment and mitigation measures.

INITIATE and maintain a log of all conversations and actions.

WELL CONTROL TEAM LEADER

Primary:	WWCI Team Leader
Reports to:	Source Control Unit Leader

GENERAL DUTIES AND RESPONSIBILITIES

1. Direct activities of the Well Control Specialist Team and support contractors involved in intervention operations.
2. Direct the activities of the Well Control Engineer (on site).
3. Coordinate assessment, planning, resource specifications, and implementation of intervention measures.

SPECIFIC DUTIES

TRAVEL to location and report to the On-Site Command Center upon notification of a well control emergency.

OBTAIN accurate reports from Source Control Unit Leader, field personnel, and Deputy Incident Commander.

ENSURE Source Control Unit Leader has directed on-site personnel in establishing the following:

- Fire watch and event log
- FIFI and asset protection
- Site Safety Plan, including exclusion or work zones
- On-Site Command Center

APPROVE planning and implementation of on-site assessment with Operations and Planning Section Chiefs and Source Control Unit Leader.

ACT as leader of all on-site well control operations.

DEVELOP initial On-Site Assessment Report in conjunction with the Operations Section Chief and Well Control Engineer.

DEVELOP the Capping Plan in conjunction with the Operations and Planning Section Chiefs and Well Control Engineer.

MONITOR the Relief Well Team progress.

ARRANGE WWCI personnel mobilization and advise Incident Commander of itinerary and ETAs.

ESTABLISH Single Point of Contact (SPOC) for Incident Commander during WWCI mobilization.

ESTABLISH SPOC for Logistics Section Chief for coordination of equipment mobilization to well site.

COORDINATE with the Well Control Safety Specialist, Source Control Unit Leader, and Well Control Engineer to ensure all hazards have been properly addressed before initial assessment or intervention measures are implemented.

COORDINATE with Well Control Safety Specialist to ensure all necessary PPE has been provided.

ATTEND daily operations and planning meetings on site.

INITIATE and maintain accurate documentation of all conversations and actions.

ENSURE that accurate field operations documentation is prepared and reported daily.

PROVIDE cost estimates/commitments for intervention operations.

EQUIPMENT LIST FOR LARGE-SCALE EVENTS

The following equipment (one each) might be deployed for a large-scale event.

Equipment Description	Supplier	Estimated Dimensions L x W x H	Estimated Weight (lb/kg)
Fire Pump: HL-250, 4,000 gpm	WWCI	186" x 82" x 91"	17,000/7,711.2
Fire Pump: HL-250, 4,000 gpm	WWCI	186" x 82" x 91"	17,000/7,711.2
Fire Pump: 6,000 gpm	WWCI	180" x 103" x 91"	16,000/7,257.47
Fire Pump: 6,000 gpm	WWCI	180" x 103" x 91"	16,000/7,257.47
20' Response Container	WWCI	20' x 8' x 7'6"	20,400/9,253.44
Fuel Tank: 500 gal (Empty)	WWCI	8' x 4'8" x 6'5"	2,900/1,315.44
Marine Manifold (New Style)	WWCI	12'5" x 7'4" x 5'2"	6,000/2,721.6
Marine Manifold (New Style)	WWCI	12'5" x 7'4" x 5'2"	6,000/2,721.6
Conventional Athey Wagon	WWCI	25'6" x 9'8" x 4'6"	19,750/8,958.6
3" Inboard Boom Section	WWCI	35'1" x 5'4" x 3'4"	3,640/1,651.1
7' Receiver Box Boom w/Cutter Attachment	WWCI	8' x 5' x 3'4"	2,200/997.92
17' Receiver Box Boom	WWCI	16'9" x 5'4" x 3'4"	3,825/1,735.02
Rake/Yoke Skid	WWCI	10'6" x 7'6" x 5'	6,000/2,721.6
Stinger Basket	WWCI	7'7" x 4'6" x 3'9"	2,600/1,179.36
A-Frame Toolbox	WWCI	8'6" x 4'6" x 5'10"	6,000/2,721.6
Flip-Up Monitor Sheds	WWCI	7'1" x 9'6" x 2'6"	1,500/680.4
Flip-Up Monitor Sheds	WWCI	7'1" x 9'6" x 2'6"	1,500/680.4
Air Compressor	WWCI	10' x 5'6" x 6'3"	5,000/2,268
Hook Boom	WWCI	331" x 66" x 46"	4,500/2,041.16
BTI Abrasive Cutter Equipment			
Abrasive Cutter	BTI	95" x 52" x 71"	6,000/2,721.6
Hose Basket for Abrasive Cutter	BTI	99" x 40" x 26"	4,500/2,041.16
Hose Reel	BTI	95" x 52" x 61"	4,500/2,041.16

Initial Incident Data

The recipient of the notification should use this form to record initial reports of emergencies and incidents.

Area	Location
Person Making Notification	**Date/Time of Notification**

Type of Emergency/Incident	☐ Spill/Release ☐ Property Damage ☐ Fire/Explosion ☐ Personal Injury/Illness/Fatality ☐ Media Coverage/Public Impact ☐ Government Agency Fine
Incident Classification	☐ Level 1 ☐ Level 2 ☐ Level 3
Date/Time of Incident	
Description of Incident	
Status/Action Taken	
Casualties/Fatalities	Yes ☐ No ☐
Number of Casualties	
Number of Fatalities	
Evacuation	Yes ☐ No ☐
All Personnel Evacuated	Yes ☐ No ☐
Destinations of Evacuees	
Assistance Required	
Agencies Notified	Yes ☐ No ☐
Name of Agencies	
Management Notified (as Appropriate) Major/Serious Incidents	Drilling Engineer ☐ Gas Control ☐ District Manager ☐ Logistics ☐ Operations ☐ Other ___________ ☐
Person Taking Report	

BLOWOUT RESPONSE ACTION/NOTIFICATION LOG

RESPONSE OPERATIONS

Job Title	
Date/Time Initial Notification Received	
Initial Notification Received From	

Date/Time	Person Contacted	Action

Comments

WELL CONTROL DATA SHEET

To Wild Well Control, Inc.

Phone: +1.281.784.4700

Fax: +1.281.784.4750

From: ______________________________

Date: ______________________________

Time: ______________________________

EVENT DESCRIPTION

ESTIMATED FLOW

Gas: _________________________________ (MMscfd)

Liquids: ______________________________ (Bpd)

Abrasive: ☐ None ☐ Moderate ☐ High

WELL CONTROL DATA SHEET (WELL CONTROL CONTRACTOR)

Current Status

CONTACTS

Emergency Response Team Contact

Name: ______________________

Title: ______________________

Phone: ______________________

Fax: ______________________

E-mail: ______________________

On-Site Contact

Name: ______________________

Title: ______________________

Phone: ______________________

Fax: ______________________

E-mail: ______________________

Has any equipment or services been ordered out to the well site? Yes ☐ No ☐

Vendor	Equipment/Material	ETA	Comments

Additional equipment on separate sheet? Yes ☐ No ☐

Additional Comments

Drilling and Production Incident Data Checklist

Well/Block Name			Date	
Responsibility	**Name**		**Contact**	
Primary				
Alternate				
Recent Situation Data		**Data Location**	**Comments**	
Well schematics showing best-known situation from events leading up to the blowout	☐			
Drilling data and formation evaluation logging reports (mud, MWD, LWD, and wireline)	☐			
Blowout flow path	☐			
Wellhead configuration	☐			
Relevant pressures	☐			
Circulation losses since last casing setting point	☐			
Status of last cement pumped	☐			
Condition of casing at incident	☐			
Last casing seat LOT (PIT) test, results	☐			

Drilling Situation		**Comments**
BOP Stack	☐	
BHA	☐	
Influx Point and Source	☐	
Fluids in Well at Time of Incident	☐	
Last Casing Seat LOT (PIT) Test	☐	
Production Blowout Situation		**Comments**
Production Tree	☐	
Casing and Tubing	☐	
Location of Packers, Valves, Perforations, and Obstructions	☐	
Type of Completion	☐	
Damage to Downhole Accessories	☐	
Squeeze Jobs Required	☐	

Reservoir and Reservoir Fluid Properties		
Permeability	☐	
Productivity Index	☐	
Static Reservoir Pressure	☐	
Reservoir Temperature	☐	
GOR	☐	
Reservoir Extension	☐	
Molecular Composition of Reservoir Fluids	☐	
Minimum Flowing BHP	☐	
	☐	
	☐	
Other Notes		

TECHNICAL DATA ARCHIVE CHECKLIST

Well/Block Name		Date	
Responsibility	**Name**	**Contact**	
Primary			
Alternate			

Office Archived Data		Location
Relevant rig or structure drawings	☐	
Well location and directional drilling coordinate system with reference systems	☐	
Rig directional drilling structure maps	☐	
Complete wellbore surveys for all wells within a 1-mile distance	☐	
	☐	
	☐	

Wellbore Surveys for Relevant Wells with Details					
Well name/number	☐	Date of survey	☐	Survey interval	☐
Surface tie-in coordinates	☐	Survey type	☐	Survey company	☐
Surveyor's name	☐	Grid convergence	☐	Magnetic declination	☐
Running gear and configuration	☐	Magnetic spacing	☐	BHA	☐
Borehole temperature	☐	Tool face used	☐	QA/QC data	☐

Recent Situation Data	
Surface maps showing rig (blowout site) and debris, pipelines, structures, and other surface hazards for a nominal 1-mile radius	☐
Surface map (plan view) of the rig showing average prevailing winds	☐
Surface map showing latest seismic coverage to include any subsurface hazards (such as shallow gas, palaeochannels, or faults)	☐
Well schematics showing best-known situation from events leading up to the blowout	☐

Drilling					
BOP Stack	☐	Wellhead Configuration	☐	Casing Program	☐
BHA	☐	Open-Hole Section	☐	Influx Point and Source	☐
Blowout Flow Path	☐	Relevant Pressures	☐	Fluids in Well at Incident Time	☐

Production					
Production Tree	☐	Wellhead Configuration	☐	Casing	☐
Relevant Pressures	☐	Blowout Flow Path	☐	Tubing	☐
Location of Packers, Valves, Perforations, and Obstructions	☐	Damage to Downhole Accessories	☐	Type of Completion	☐
Geological stratigraphic cross section to include pore pressures, fracture gradients, overburden, and temperature profile; mark all possible drilling hazards					☐
Drilling records from the blowout and offset wells, including detailed record of drilling and production operations immediately prior to the blowout					☐
Drawdown production tests or DST if available					☐
Drilling data and formation evaluation logging reports (mud, MWD, LWD, and wireline)					☐
Status of last cement pumped					☐
Condition of the casing at the time of the incident					☐
Performance of last casing seat LOT (PIT) and use of squeeze jobs					☐
Circulation losses encountered since the last casing setting point					☐

Reservoir and Reservoir Fluid Properties					
Productivity Index	☐	Static Reservoir Pressure	☐	Reservoir Temperature	☐
GOR	☐	Reservoir Extension	☐	Molecular Composition of Fluids	☐
Molecular Composition of Reservoir Fluids	☐	Permeability	☐	Minimum Flowing BHP	☐

PERSONNEL DEBRIEFING CHECKLIST

Well/Block Name		Date	
Briefing Question		**Comments**	
Was there an indication that any BOPs or VALVES failed to actuate when energized?	☐ Yes ☐ No		
Any indication of a WASHOUT in the pipe string?	☐ Yes ☐ No		
Any unusual PRESSURE FLUCTUATIONS noticed?	☐ Yes ☐ No		
Any OTHER OCCURRENCES that seem out of the ordinary prior to the incident? Describe.	☐ Yes ☐ No		
Were there any SAFETY VALVES or INSIDE BOPs in the pipe string? (If yes, what is the status of these valves?)	☐ Yes ☐ No		
Are there any NIPPLES/FLOATS/PLUGS in the string? (If yes, describe status.)	☐ Yes ☐ No		
What was the last recorded SIDPP?			
What was the last recorded SICP?			
What was the MUD WEIGHT (in/out) at the time of the incident?			
What was the last recorded PIT GAIN?			
What EQUIPMENT is CONNECTED to the BOP stack/wellhead (pump lines, wireline lubricator, and coiled tubing injector)?			
What is the status of all RAMS and VALVES on the BOP stack/wellhead (open, closed, damaged, locked)?			

Well/Block Name		**Date**	
Describe the WELL CONFIGURATION and OPERATION at the time of the incident (drilling, fishing, running casing, cementing, and workover/completion operations).			
REVIEW STEP-BY-STEP what each person was doing two hours prior to, during, and after the incident.			
Any additional data			

SITE SURVEY CHECKLIST

Well/Block Name		**Date**	
Responsibility	**Name**	**Contact**	
Primary			
Alternate			

GENERAL SITUATION

1. Determine which wells are out of control and whether they are on fire.
2. Determine whether there is easy access to the wellheads.
3. Determine amount of debris that must be removed.
4. Determine potential for erosion.
5. Determine predominant wind speed and direction.
6. Provide heat radiation estimates (or measurements).
7. Determine other obvious or potential hazards.

EQUIPMENT STATUS

1. Determine general rig damage.
2. Determine condition of wellhead/conductor pipe (vertical, structurally competent).
3. Determine whether there is any significant damage to surface equipment.
4. Determine whether surface equipment is capable of being shut in.
5. Predict additional structural damage or secondary involvement due to fire.

SPILL STATUS

1. Determine blowout fluid composition (percentage salt water, oil, gas, condensate, sand).
2. Determine size of the oil column, gas/condensate cloud, or fire.
3. Determine blowout fluid exit point and description of flow (vertical, obstructed, through valve, through drill pipe).
4. Determine whether poisonous gases are present at dangerous levels.
5. Determine stability of flow (remaining constant, increasing, decreasing, changing composition).
6. Provide pollution/spill summary.

Appendix B – National Incident Management System Abbreviations

Abbreviation	Definition
CIKR	Critical Infrastructure and Key Resources
CPG	Comprehensive Preparedness Guide
DHS	Department of Homeland Security
DOC	Department Operations Center
EMAC	Emergency Management Assistance Compact
EMS	Emergency Medical Services
EMT	Emergency Medical Technician
EOC	Emergency Operations Center
HSPD-5	Homeland Security Presidential Drive 5, “Management of Domestic Incidents”
HSPD-7	Homeland Security Presidential Drive 7, “Critical Infrastructure Identification, Prioritization, and Protection”
HSPD-8	Homeland Security Presidential Directive 8, “National Preparedness”
IAP	Incident Action Plan
IC	Incident Commander
ICP	Incident Command Post
ICS	Incident Command System
IMT	Incident Management Team
IPS	Integrated Planning System
JIC	Joint Information Center
JIS	Joint Information System
MAC	Multiagency Coordination
MACS	Multiagency Coordination System
NFPA	National Fire Protection Association
NGO	Nongovernmental Organization
NIC	National Integration Center
NIMS	National Incident Management System
NIPP	National Infrastructure Protection Plan
NRF	National Response Framework
NSPD	National Security Presidential Directive
SDO	Standards Development Organization
TCL	Target Capabilities List
UC	Unified Command

APPENDIX C – OIL AND GAS ABBREVIATIONS

Abbreviation	Definition
AFE	Authorization for Expenditure
bbl	Barrel (42 US Gallons)
BHA	Bottom-Hole Assembly
BHP	Bottom-Hole Pressure
BOP	Blowout Preventer
bpm	Barrels per minute
BPV	Back-Pressure Valve
BSR	Blind Shear Ram
C&K	Choke and Kill
CFM	Cubic Feet per Minute
CMR	Crisis Management Room
CMT	Crisis Management Team
CP	Command Post
csg	Casing
DC	Drill Collars
DP	Drill Pipe
ECD	Equivalent Circulating Density
EMS	Electromagnetic Survey
EMW	Equivalent Mud Weight
ERC	Emergency Response Center
ERO	Emergency Response Organization
ESD	Emergency Shutdown
ETA	Estimated Time of Arrival
FIFI	Firefighting
FIT	Formation Integrity Test
FRC	Fire-Resistant Clothing
ft	Foot, feet
gpm	Gallons per minute
GOR	Gas/Oil Ratio
GR	Grade
HP	Horsepower
HR	Human Resources
HWDP	Heavyweight Drill Pipe
ID	Inside Diameter
IADC	International Association of Drilling Contractors
IAP	Intervention Action Plan

ICO	Incident Command Organization
ICS	Incident Command System
IRS	Incident Response Structure
kh	Formation flow capacity (also mD-ft, where mD = millidarcy)
KOP	Kickoff Point
LCM	Lost-Circulation Material
LEL	Lower Explosive Limit
LOT	Leakoff Test
LWD	Logging While Drilling
Mscf/d	Thousand Cubic Feet Per Day
mD-ft	See *kh*
MD	Measured Depth
MUX	Multiplex
MWD	Measurements While Drilling
MWe	Megawatt electrical
O.D.	Outside Diameter
OBM	Oil-Based Mud
ORT	On-Site Response Team
OSCP	Oil Spill Contingency Plan
OSD	Oil Spill Detection
PA	Public Affairs
P&A	Plug and Abandon
PIT	Pressure Integrity Test
POOH	Pulling Out of Hole
PPE	Personal Protective Equipment
ppg	Pounds per gallon
ppm	Parts per million
psi	Pounds per square inch
PWD	Pressure While Drilling
RU	Rig Up
SBM	Synthetic-Based Mud
SCFD	Standard Cubic Feet per Day
SICP	Shut-In Casing Pressure
SIDPP	Shut-In Drill Pipe Pressure
SimOps	Simultaneous Operations
SPOC	Single Point of Contact
tbg	Tubing
TD	Total Depth
TVD	True Vertical Depth

UGBO	Underground Blowout
UHF	Ultrahigh Frequency
USI	Ultrasonic Imaging
VHF	Very-High Frequency
VIV	Vortex-Induced Vibration
WCE	Well Control Engineer
WCERO	Well Control Emergency Response Organization
WCERP	Well Control Emergency Response Plan
WCERT	Well Control Emergency Response Team
WOO	Wait on Orders
WP	Working Pressure
wt	Weight
WWCI	Wild Well Control, Inc.

APPENDIX D – H_2S OPERATIONS

Hydrogen sulfide (also known as H_2S, sour gas, poison gas) is a toxic, corrosive, explosive, and colorless gas found in many oil and gas reservoirs throughout the world. H_2S is easily perceptible at concentrations well below 1 part per million (ppm) in air. However, when the concentration of H_2S increases above 100 ppm, H_2S paralyzes the olfactory nerve and the smell is imperceptible. This means that the gas can be present at lethal concentrations with no perceivable odor. Prolonged exposure to lower concentrations can also result in similar olfactory fatigue.

The unusual olfactory-fatigue property associated with H_2S makes it extremely dangerous to rely only on the sense of smell to warn of H_2S presence. After a period of exposure, the smell of H_2S might no longer be detectable; the higher the concentration, the shorter the period.

TOXICITY OF H_2S AND COMMON EFFECTS OF EXPOSURE

Prolonged exposures to H_2S can be hazardous, even at low levels. The legal limit for working in H_2S atmospheres in the US is less than 10 ppm time-weighted average (TWA). This limit applies to an 8-hour workday.

The table below outlines the effects of exposure to different concentrations of H_2S for various periods of time. This information should be used as a guideline, as the effects of exposure on individuals vary.

Table D.1 – Common Effects of H_2S Exposure

Level of Effect	H_2S Concentration (ppm in Air)	Exposure Time (Minutes)	Common Symptoms/Features
Odor Threshold	0.01*	> 1	• Characteristic smell of rotten eggs (subjective)
Irritation	10	360	• Redness of eyes; nose and throat irritation

* Odor threshold varies with the individual from as low as 0.0005 ppm to as high as 0.15 ppm.

Level of Effect	H_2S Concentration (ppm in Air)	Exposure Time (Minutes)	Common Symptoms/Features
Moderate	10–50 ppm		• Dizziness • Headache • Nausea/vomiting • Difficulty breathing
Vision	50	60	• Acute conjunctivitis (gas eye)
Sense of Smell	150	2–15	• Loss of sense of smell (subjective)
Serious Injury	150	60	• Respiratory distress • Signs of nervous system injury, convulsions (in nearly fatal cases)
	500	30	
	700	15	
Fatal**	500	60	• Immediate unconsciousness • Respiratory distress
	700	30	
	900	15	

At the fatal level, H_2S is rapidly absorbed into the bloodstream, overloading the body's natural capacity to process the absorbed mass. Consequently, H_2S affects the respiratory nerve center, which causes breathing to stop. At serious-injury levels (such as 500 ppm for 30 minutes), the exposed person will have serious respiratory distress and is at risk of dying if he does not receive immediate artificial respiration and emergency medical attention. Concentrations in excess of 10 ppm should be considered a health hazard. Exposure without proper gear should be avoided.

In order to comply with the exposure threshold limit value (TLV) of 10 ppm in an 8-hour workday, living quarters for the emergency response team should be upwind and of sufficient distance from the blowout such that the average ground level concentrations do not exceed 1 ppm. (1 ppm = 1 cm^3/m^3 = 1.4 mg H_2S per cubic meter of air at standard temperature and pressure.)

15 ppm is the short-term exposure limit (STEL) as published by the American Conference of Government Industrial Hygienists (ACGIH) in 1984. The STEL is the maximum

** A person exposed to 900 ppm H_2S for 15 minutes, 700 ppm for 30 minutes, or 500 ppm for 60 minutes will die.

concentration to which a worker might be exposed for a period of up to 15 minutes without harmful effects. No more than four excursions above the TLV should be permitted in any one day. At least 60 minutes between exposure periods and the daily TWA must not exceed the TLV.

Well Control

Well control procedures are basically the same in the presence of H_2S, but the added risk of personnel exposure has an impact on the decision-making process for handling a given well control situation. Extra consideration should be given to items such as remote kill lines, remote adjustable choke control panels and remote BOP controls.

Any influx into the wellbore (kick) should be assumed to contain H_2S. The size of the influx, amount of underbalance, formation character, weather conditions, and other factors should be considered when deciding to circulate out or pump away the influx. If the decision is made to circulate out the kick, clear the rig floor and shaker/choke/gas buster area of all unnecessary personnel, and take the following precautions:

- Rope off the rig substructure, BOP, choke line, choke manifold, and mud return areas, and identify as a restricted area. No one may enter these areas without breathing apparatus, H_2S monitor, and specific superintendent's approval.
- Continuously monitor the H_2S concentration in the mud returns.
- The Drilling Foreman will alert affected downwind facilities as identified in the workover program.
- The Drilling Foreman will implement any additional precautions he deems prudent.
- When circulating, all personnel involved in the well control operation will mask up at least 30 minutes prior to bottoms up. The flow from the choke should be diverted through the gas buster, and the gas should be flared. The mud stream will return to the active system, where any remaining gas can be removed by the degasser and the use of an H_2S scavenger.

If the decision is made to pump away the influx, a procedure should be furnished by the engineer based on actual conditions at the time. This will generally involve pumping down the tubing or work string at a slow rate while bullheading on the annulus with the same mud weight as in the hole, or with kill-weight mud if weight-up can be accomplished quickly. When drill pipe and casing pressure are equal, it can be assumed that the influx is pumped away (an additional volume of mud should be pumped for safety). Kill-weight mud can then be circulated in the well to hold the appropriate back pressure on the choke.

Stripping operations in the presence of H_2S are particularly hazardous due to increased stress cracking at low temperatures and high stress levels. If an influx occurs while out of the hole or off bottom, pumping away the influx should be considered prior to initiating stripping operations.

Heavy trip-gas concentrations should be diverted through the gas buster and flared, if possible.

H_2S Training Requirements

The level of orientation or training required will vary, depending upon the role each individual is expected to take in the event of an H_2S release. The following should be considered as minimum training requirements.

Table D.2 – Minimum H_2S Training Requirements

Personnel	Minimum H_2S Training Requirements
Occasional visitors – never (or rarely) on the rig floor	• Able to identify H_2S alarm • Able to identify wind direction • Know to evacuate to the upwind Safe Briefing Area immediately upon hearing the alarm
Visitors who might work on the rig	• Able to don and use breathing apparatus • Able to identify H_2S alarm • Able to identify wind direction • Know to evacuate to the upwind Safe Briefing Area immediately upon hearing the alarm
Rig crew	• Able to don and use breathing apparatus • Able to identify H_2S alarm • Able to identify wind direction • Know how to perform the tasks assigned to them, according to the rig's H_2S drill

In addition to these specific training requirements, the following general requirements should be followed:

- The H_2S Safety Representative should immediately begin training crews, ensuring that everyone on the rig site has received an H_2S orientation. Records of H_2S safety training and orientation are to be recorded in the H_2S safety-training file.

- H_2S drills should be held as often as deemed necessary by the Superintendent and the H_2S Safety Representative, until satisfactory performance is obtained. Thereafter, safety drills should continue to be conducted once per week per crew. These weekly drills will be documented in the IADC morning report book.

- The ORT Leader will designate two Safe Briefing Areas such that at least one will always be upwind of the wellbore under prevailing wind conditions. The primary area will be near the Contractors' offices (generally upwind). This upwind location will be a gathering point for all drills.

- The ORT Leader will ensure that a sign is posted notifying all visitors to report to the office to verify that they receive or already have completed H_2S orientation. The Superintendent can delegate these duties, but he remains responsible for their implementation.

SAFETY IN AN H_2S-EXPOSED AREA

It is important for personnel in an H_2S-exposed area to have appropriate safety equipment. Additionally, there are recommended actions that can be taken during evacuation and rescue to protect exposed personnel from further danger.

Safety Equipment

Safety equipment should be available in the Safe Briefing Area during times when H_2S is present in the atmosphere at the rig. The primary Safe Briefing Area will be near the Contractors' offices. H_2S safety equipment should include the following items, at a minimum:

- Alarm sensor

- Alarm controller

- Visual and audible alarms

- Breathing apparatus

If the H_2S concentration is or might become greater than 10 ppm, a self-contained breathing apparatus must be worn.

- Wind socks
- Breathing-air compressor
- Cascade-type breathing system

When working in an H_2S environment for a prolonged period of time, a cascade air-breathing apparatus must be used.

- Manual-type H_2S concentration sensors
- Chalkboard or whiteboard and markers

When not in use, this equipment can be stored in the adjacent offices, H_2S safety trailer, or other location as deemed by the Superintendent, as long as it is readily available.

Evacuation and Rescue

During evacuation, the following actions can help to protect personnel from further harm:

1. Hold your breath.
2. Put on an escape SCL.
3. Evacuate to safe evacuation/meeting area (upwind).
4. Do not panic.

Rescuing a person overcome by H_2S exposure can put the rescuer in danger. In order to prevent further harm, the rescuer must adhere strictly to the following procedure:

1. Put on self-contained breathing apparatus (30 minutes).
2. Have second man as backup with self-contained breathing apparatus (30 minutes) available.
3. Bring casualty back to Safe Briefing Area.
4. Immediately apply mouth-to-mouth artificial respiration, followed as soon as possible by resuscitation.

5. Summon expert medical assistance as soon as possible.

6. Do not panic.

BOP Equipment

ALERT: H_2S can have an adverse effect on well control equipment.

With assistance from the Tool Pusher or Senior Contractor Representative, the Drilling Foreman will inspect and ensure that BOP and surface equipment are of metallurgy suitable for H_2S service, meeting the standards set forth in NACE Standard MR-01-75. This inspection and verification should be completed well in advance of nipple-up so that any changes can be made if necessary.

The Drilling Foreman and well site mud engineer should also confirm that an H_2S scavenger (zinc oxide or an equivalent scavenger) is available, with sufficient quantity on location to treat the entire mud system with 2 lb/bbl, or as required.

Operating Conditions (Alarm Levels)

The Drilling Foreman, with assistance from the H_2S Safety Representative, should ensure the following on operations where the presence of H_2S is possible:

- All safety equipment for H_2S operations is in place as required prior to starting operations.
- Sensors and warning devices are rigged up and working properly prior to starting operations.
- Supplied-air (cascade) manifold gauges are checked for proper pressure and air lines are checked for proper operation every tour (at every crew change). This is documented in the IADC book.
- All personnel are trained and fully briefed on H_2S procedures and prepared for handling H_2S emergencies.
- No one should work alone. All personnel must work in pairs (the “buddy system”).

The Drilling Foreman is responsible for taking every practical precaution to maintain a safe working environment while remedial actions are being taken to reduce the amount of H_2S present at the surface. When working on a well where H_2S is possible, the rig will conduct operations based on the following classifications of H_2S risk (where “[H_2S]”

using square brackets refers to H_2S concentration, usually measured in ppm [parts per million]):

Table D.3 – H_2S Alert Levels

Alert Level	H_2S Concentration $[H_2S]$	Comments
Level 0	0 ppm	Normal operations
Level 1	0–10 ppm	Normal operations, with increased alertness, preparing for next level. Restricted access to affected areas.
Level 2	10–100 ppm (but not on drill floor)	Restricted access and breathing apparatus required in affected areas, where $[H_2S]$ > 10 ppm. Nonessential personnel removed from rig. Immediate action taken to reduce mud H_2S levels. • First alarm at 10 ppm, high alarm at 20 ppm
Level 3	10–100 ppm (on the drill floor)	Approaching an emergency situation • First alarm at 10 ppm, high alarm at 20 ppm
H_2S Emergency	> 100 ppm	Actions taken to reduce H_2S concentrations have failed and an emergency situation has been reached. (This is not necessarily an uncontrolled release, but would include uncontrolled releases.)

Level 0: $[H_2S]$ = 0, Normal Operations in Potential H_2S Zones

This is the base level, in effect at all times on wells where H_2S is possible. The following precautions should be maintained, even when no H_2S has been detected:

- All H_2S detection equipment will be function tested daily and documented in the IADC book.
- H_2S detection equipment will be calibrated weekly and documented in the rig PM file.

- All breathing apparatus, detectors, alarms, and other safety equipment will be in place and ready for immediate use.
- Two Safe Briefing Areas have been marked out and identified, and the entrance sign has been posted.
- H_2S drills will continue at a minimum of once per week per crew and will be documented in the IADC daily report form.
- Orientation and training on breathing apparatus will continue so that new arrivals and visitors are covered. (See Table D.2.)

Level 1: [H_2S] = 0–10 ppm, Acceptable Amount of H_2S Present

Level 1 begins whenever H_2S is detected anywhere on the rig. Typically, this will be at the shale shaker, when safe concentrations (less than 10 ppm) of H_2S are being released to the atmosphere. Although this is a safe H_2S concentration, everyone must be alert to the fact that the H_2S concentration could increase at any time.

Upon reaching Level 1 conditions, the Drilling Foreman will ensure the following actions are taken:

- Verify all of the previous H_2S level precautions are already in place.
- The area around the shale shaker and the rig cellar will be declared restricted areas. No one may approach these areas without the following:
  - Ready access to breathing apparatus
  - Continuous awareness of current H_2S concentration by means of a personal H_2S monitor giving continuous readouts
  - Continuous observation by a standby man who also has immediate access to breathing apparatus (the “buddy system”)
- Appropriately rated (explosion-proof) bug blowers will be positioned to provide adequate ventilation to H_2S contaminated areas and the rig floor.
- The Tool Pusher or designated H_2S Safety Representative will conduct an initial H_2S safety meeting with each crew. H_2S safety will be discussed at a brief toolbox safety meeting at every shift change.

- The H_2S concentration in the mud is checked a minimum of every 24 hours, or more frequently at the Drilling Foreman's discretion. The Garret Gas Train Kit will be used for this determination.
- Identify possible courses of action to take should the H_2S concentration increase to higher levels (such as stopping circulation or treating mud with H_2S scavenger).
- Take appropriate actions to maintain H_2S levels below 10 ppm.

The objective is to minimize the number of times the H_2S alarms sound. If the 10 ppm H_2S alarm becomes excessive, it could contribute to complacency and lose its desired effect as a warning.

LEVEL 2: [H_2S] = 10–100 PPM (ANYWHERE BUT ON THE RIG FLOOR)

Company policy requires breathing apparatus to be worn when working in an atmospheric H_2S concentration higher than 10 ppm. Therefore, every practical precaution will be taken to either reduce atmospheric H_2S levels to less than 10 ppm, or to declare "off limits" those areas with an atmospheric H_2S concentration higher than 10 ppm.

Upon reaching Level 2 conditions, the Drilling Foreman will ensure the following actions are taken:

- Verify all of the previous H_2S level precautions are already in place.
- The rig crew will respond to the low level ([H_2S] >10 ppm) alarm with their H_2S drill (as previously trained).
- The Drilling Foreman, assisted by the senior contractor representative, will identify the source of the H_2S, and respond accordingly. For example, if the H_2S release is confined to the shale shaker area only, that is not as critical a situation as [H_2S] > 10 on the drill floor.
- Handheld H_2S monitors will be used to measure atmospheric H_2S concentrations continuously.
- The Drilling Foreman will implement appropriate procedures to reduce atmospheric H_2S levels in the affected areas (such as treating mud with H_2S scavenger, increasing overbalance, controlling ROP, or increasing ventilation to area).

- The H_2S concentration in the mud will be checked every 4 hours, or as directed by the Drilling Foreman. The Garret Gas Train Kit will be used for this determination.
- Breathing apparatus must be worn when entering an area with atmospheric H_2S concentration higher than 10 ppm. No one may remain in an area with [H_2S] > 10 ppm unless their presence is absolutely necessary to regain a safe working environment.
- A strict buddy system will be enforced throughout the rig and immediately downwind of the rig.
- The rig substructure, shale shaker area, and any other areas with [H_2S] > 10 ppm will be roped off and identified as a restricted area. No one may enter these areas without specific Drilling Foreman approval.

Level 3: [H_2S] = 10–100 ppm (on the Drill Floor)

Since the rig floor is a critical work area and cannot be easily evacuated, H_2S concentrations higher than 10 ppm are far more critical here than in more remote areas of the rig.

Upon reaching Level 3 conditions, the Drilling Foreman will ensure the following actions are taken:

- Verify all of the previous H_2S level precautions are already in place.
- Upon initial low alarm ([H_2S] > 10 ppm), everyone on the rig floor will either evacuate or mask up, per the established H_2S drill.
- No one may remain on the rig floor unless his or her presence is absolutely necessary to regain a safe working environment.
- An H_2S monitor will be placed on the rig floor to provide continuous atmospheric H_2S concentrations.
- The Drilling Foreman will use his discretion whether to circulate through the choke or through the shakers.
- The Drilling Foreman will immediately implement appropriate procedures to reduce H_2S concentration in the mud (such as stopping circulation, treating mud with H_2S scavenger, increasing overbalance, or increasing ventilation).

- Two men will be placed at each entrance to the location to turn back nonessential personnel and to direct essential personnel to the appropriate Safe Briefing Area. These teams will be equipped with breathing apparatus and H_2S monitors.
- The Drilling Foreman will discuss extended-term procedures to reduce H_2S levels with his superintendent or immediate supervisor.

H_2S Emergency: $[H_2S] > 100$ ppm

An H_2S Emergency is defined as having lost the capability to control the amount of H_2S being released at the well site. Under this condition, the Drilling Foreman must identify the problem and take immediate corrective action to provide an adequate level of safety for the men working on the rig.

Upon reaching an H_2S Emergency condition, the Drilling Foreman will ensure the following actions are taken:

- Immediately implement a strict buddy system, in which no one is to ever do anything alone. Every task must be done in pairs.
- The Drilling Foreman will notify the Superintendent or his immediate supervisor of the emergency. The Superintendent will decide whether or not to activate further emergency-response measures.
- Communicate to the Superintendent what outside resources the rig needs or might need in the immediate future (such as gas monitors, gas-monitoring teams, increased breathing-apparatus refill capacity, mobile radios, or walkie-talkies). The Superintendent will contact the outside resources needed to assist the rig.
- Establish a CP, typically in the rig-site office, equipped with the following:
  - Telephone and radio
  - Continuous contact with the workover superintendent
  - Flare gun and one box of flare gun shells
  - Fluorescent orange vest to identify the On-Scene Commander
  - Walkie-talkies to communicate with the Safe Briefing Area and work parties throughout the rig
  - Continuous manning by either a foreman or a highly reliable, experienced, and competent individual, plus at least two pairs of runners

- Man the primary Safe Briefing Area, equipped as specified.
- Establish and mark off a “Hot Zone” where H_2S concentration is greater than 10 ppm. This is done by assigning pairs of individuals who are masked up and equipped with a continuous H_2S monitor to measure H_2S concentrations throughout the location.
- Maintain at least one two-man team to continuously check that the “Hot Zone” is adequately identified. (Winds can vary and change conditions rapidly.)
- Assign an individual to gather all vehicles and park them in a safe upwind location, parked facing their escape route, with the motor off and with the keys in the ignition.
- Alert the rig camp of the emergency, and to stand by for further instructions.

Under emergency conditions, it might be difficult for one man to directly supervise more than four people.

- Organize small work teams of at least two, but usually not more than five, men. Assign one man as leader of every work team.
  - Each work team will have an individual assigned to check the air supply of all team members and to monitor H_2S levels using a continuous monitor. This should be his primary responsibility: he should not be assigned other duties that could interfere with this vital safety function.
  - All work is assigned to individual teams at the Safe Briefing Area.
  - The Safe Briefing Area Commander keeps a written log of all assigned tasks.
  - Each work team is assigned only one task.
  - An estimated time of completion is identified for each assigned task.
  - Each work team reports back to the Safe Briefing Area immediately upon completion of their assigned task, allowing the Safe Briefing Area Commander to be fully up-to-date on the progress being made.
  - If a work team has not completed their task by their estimated time of completion, they will report back to the Safe Briefing Area (or send a pair of runners to report in).

SPECIAL OPERATIONS

Well Testing

A well test might be included in the workover operations. The following conditions should apply any time a well test is done in a potential H_2S zone:

- Special well test procedures that outline the contingency planning for an H_2S emergency should be written prior to the testing operation. These procedures should be thoroughly discussed with all personnel involved in the well test operation. Special provisions required by any local governmental authority should also be incorporated into the test procedure.
- Prior to initiation of the test, special safety meetings must be conducted by the H_2S Safety Representative for all personnel who will participate. This will require at least two meetings to include both crews. Special emphasis should be placed on use of personal safety equipment, evacuation to the Safe Briefing Area, rescue operations, and first-aid procedures.
- The test should be conducted with the minimum number of personnel on the rig floor and in the vicinity of the lines and test equipment to safely conduct the test. Other personnel should be assigned duties in an upwind area away from the cellar, rig floor, lines, and test equipment.
- Downhole test tools and surface equipment should be suitable for H_2S service and supplied by a reputable testing contractor. All items from the test head (or tree) to the choke manifold and well test equipment should be furnished by the well test company.
- During the test, the use of H_2S portable detection equipment will be intensified. All produced gases must be burned through a flare system equipped with a continuous pilot and an automatic igniter. At least one backup ignition device must be provided. Produced fluids that are stored must also be vented to the flare pit. If well is within 5 km of a contact point, portable H_2S monitoring must be done downwind of the flare pit in case the flare cannot be kept burning continuously. Two people, both masked up, should conduct this monitoring.
- There should be two flare pits when the gas is to be flared. The primary pit is for flaring, and the secondary pit is for emergency well control operations only, such as when the gas buster cannot handle pressure or volume, or for diverting an uncontrolled flow.
- The testing of all wells should be initiated only during daylight hours.

Lost Circulation

Lost circulation becomes a serious problem when it occurs with a formation containing open H_2S, especially if that formation has a minimal overbalance. As with well control, the presence of H_2S does not change how the situation is handled, rather it impacts the decision-making process on which options to take. A more conservative approach is warranted, with more attention given to preventative maintenance.

If the hole will not stand full, it is very important to keep the hole filled with mud, water, or diesel and record the exact volume pumped so that an accurate hydrostatic head can be calculated if the well becomes static.

LCM materials should be kept on hand so that the situation can be dealt with in a timely manner.

APPENDIX E – VOLUNTARY WELL IGNITION

This appendix discusses considerations for the development and execution of a Well Ignition Plan (WIP). The API RP 68, *Recommended Practice for Oil and Gas Well Servicing and Workover Operations Involving Hydrogen Sulfide*, indicates that a WIP should be written for wells containing dangerous H_2S levels. Development of a formal WIP for all well types should be considered based on the risk level of the well, its location, and the environment. For the purposes of this document, the use of "well" is generic and refers to a well, pipe, pipeline, equipment, and any other component that could leak and require the consideration of possible voluntary ignition.

This appendix contains information about the following topics:

- WIP
- Well Ignition Roles and Responsibilities
- Preliminary Actions in Anticipation of Possible Ignition
- Well Ignition Criteria/Decision Map
- Well Ignition Procedure
- Well Ignition Field Checklist

WIP

The WIP can be written as a standalone document or included in the WCEMP. In the absence of a formal plan, organizations should at least consider that there might be circumstances requiring the ignition of a blowout and the need to take appropriate actions. When considering voluntary ignition during well planning and operations, examine the following topics and effects:

- Risk factors contained in the well ignition plan or WCERP
- Ignition of nontoxic blowouts
- Ignition of H_2S wells
- Ignition methods
- Effects of radiant heat and other postignition factors

After consideration of the factors in the individual case, it might be found that it is safest and in the best interest to set the well on fire. An example of a case where implementation of voluntary ignition is likely beneficial is when a large concentration of H_2S is released to atmosphere close to residential areas or highly traveled roads.

The typical WIP should include the following elements:

- Preliminary actions in response to the emergency and in preparation for possible well ignition
- Clear and timely consideration of the issues that support a decision to ignite the well
- Clear identification of the persons or positions authorized to carry out ignition
- Descriptions of the actions to be taken prior to ignition, such as establishing the perimeter of the dispersing vapor cloud, setting up an appropriate exclusion zone, and verifying evacuation
- Description of availability and location of ignition equipment
- Actual ignition procedure and cautions
- Consideration of the effects and actions to be taken following the ignition

Well Ignition Roles and Responsibilities

When considering the decision of igniting a well, the roles and responsibilities for taking that action must be clearly defined and understood. Since time is often a critical factor in responding to the protection of persons, property, and the environment, the final responsibility for deciding to ignite a well rests on the most senior Company person on site at the event. That person is thought to have the closest perspective to the situation, data, and impacts. If time permits, this person should take every opportunity to consult with Well Control Engineers, the ORT, and Marathon ICS, as well as other personnel and resources internal or external to the Company. A generic roles-and-responsibilities relationship is illustrated in Figure E.1.

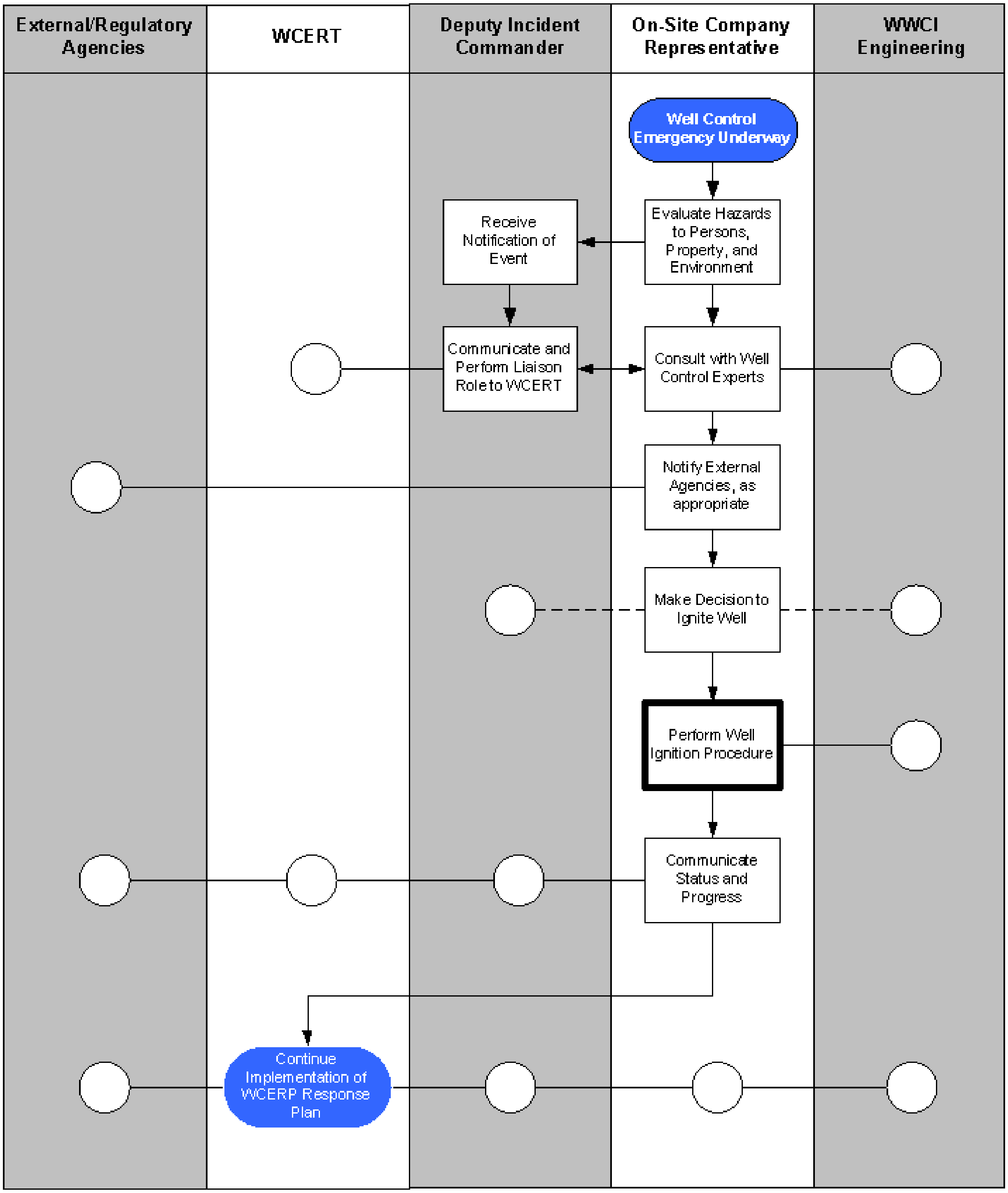

Figure E.1 – Well Ignition Roles and Responsibilities

Preliminary Actions in Anticipation of Possible Ignition

The preliminary actions to be taken in the event of a well control incident are typically addressed in detail in the Company's Emergency Response Plan, WCEMP, the Site Safety Plan (SSP), or other documents. More specific and detailed information regarding H_2S Operations can be found in industry resources as well as API RP 68.

The Company representative on location, with assistance from the Site Safety Specialist, should verify the following where the presence of H_2S is possible or probable:

- All safety equipment for H_2S operations is in place as required prior to starting operations.
- Sensors and warning devices are rigged up and properly working prior to starting operations.
- Supplied-air (cascade) manifold gauges are checked for proper pressure and air lines are checked for proper operation every tour (at every crew change). This is documented in the IADC book.
- All personnel are trained and fully briefed on H_2S procedures and prepared for handling H_2S emergencies.

These are general guidelines for the monitoring of operating conditions, and preliminary actions to be taken in the event of a well control incident that might require ignition. The Company representative on location is responsible to take every practical precaution to maintain a safe working environment while remedial actions are being taken to reduce the amount of H_2S present at the surface.

Additional Actions to be Taken in an H_2S Emergency: $[H_2S] > 100$ ppm

An H_2S Emergency is defined as having lost the capability to control the amount of H_2S being released at the well site. Under this condition, the Company representative on location must identify the problem and take immediate corrective action to provide an adequate level of safety for the men working on the rig.

Upon reaching an H_2S Emergency condition, the Company representative on location will ensure the following actions are taken:

- Immediately implement a strict buddy system, in which no one is to ever do anything alone. Every task must be done in pairs.
- When a blowout is detected or has occurred, all ignition sources should be isolated, if possible.
- The Company representative on location will notify the superintendent or his immediate supervisor of the emergency. The superintendent will decide whether or not to activate further emergency-response measures.
- Evacuate the area, as appropriate, due to concentration of toxic or flammable materials as well as when the well control procedures are not progressing as expected. Isolate and deny entry into the area, including all adjacent communities and roadways.
- Communicate to the superintendent what outside resources the rig needs or might need in the immediate future (such as gas monitors, gas-monitoring teams, increased breathing-apparatus refill capacity, mobile radios, or walkie-talkies). The superintendent will contact the outside resources needed to assist the rig.
- Establish a CP, typically in the Company rig-site office, equipped with the following:
    - Telephone and radio
    - Flare gun and one box of flare gun shells
    - Fluorescent orange vest to identify the Company representative on location
    - Walkie-talkies to communicate with the Safe Briefing Area and work parties throughout the rig
    - Continuous manning by either a Company representative on location, or a highly reliable, experienced, and competent individual, plus at least two pairs of runners
- Man the primary Safe Briefing Area, equipped as specified.

- Establish and mark off a “Hot Zone” where H_2S concentration is greater than 10 ppm. This is done by assigning pairs of individuals, masked up and equipped with a continuous H_2S monitor, to measure H_2S concentrations throughout the location.
- Maintain at least one two-man team to continuously check that the “Hot Zone” is adequately identified. (Winds can vary and change conditions rapidly.)
- Evacuation zones are always located upwind and determined to be a minimum of 1 mile or 0 percent LEL, whichever is greater.
- Assign an individual to gather all vehicles and park them in a safe upwind location, parked facing their escape route, with the motor off, and with the keys in the ignition.
- Alert the rig camp of the emergency and to stand by for further instructions.
- Under emergency conditions, it might be difficult for one man to directly supervise more than four people. Organize small work teams of at least two, but usually not more than five, men. Assign one man as leader of every work team.
  - Each work team will have an individual assigned to check the air supply of all team members and to monitor H_2S levels using a continuous monitor. This should be his primary responsibility. He should not be assigned other duties that could interfere with this vital safety function.
  - All work is assigned to individual teams at the Safe Briefing Area.
  - The Safe Briefing Area commander keeps a written log of all assigned tasks.
  - Each work team is assigned only one task.
  - An estimated time of completion is identified for each assigned task.
  - Each work team reports back to the Safe Briefing Area immediately upon completion of their assigned task, allowing the Commander to be fully up-to-date on the progress being made.
  - If a work team has not completed their task by their estimated time of completion, they must report back to the Safe Briefing Area (or send a pair of runners to report).

WELL IGNITION CRITERIA

The recommended practices of API RP-86 indicate that the decision to ignite the well should be made only as a last resort, and only then when the following is clear:

- Human life and property are endangered.
- There is no hope of controlling the well under the prevailing conditions at the well site.

ERCB Directive 071, *Emergency Preparedness and Response Requirements for the Petroleum Industry*, adds that timely ignition (within 15 minutes) is required when any one of the following elements is present:

- Evacuations have not taken place, even if notified.
- H_2S levels over 10 ppm detected in unevacuated areas.
- H_2S concentrations in excess of 1 ppm (1-hour average) detected in urban density developments.
- Monitoring not taking place on wells with known high H_2S concentrations.

The decision to ignite or not ignite the well requires a quick and thorough assessment of the conditions at the well site and the immediate vicinity. Delays could create additional threat scenarios for site personnel and communities within the immediate area. IN ALL CONDITIONS, notify the local emergency-response organizations that a well control problem exists and that the decision to ignite the well is being considered.

The methodology for determining voluntary well ignition involves the following:

1. Understand conditions prior to any decision to voluntarily ignite a blowing gas/oil well.
2. Follow identified protocols and authorities for determining ignition.
3. Identify alternatives to voluntary ignition, if practical.
4. Identify methods to ignite and sustain the ignition.
5. Develop concepts for minimizing collateral damage.

Voluntary Well Ignition Generic Decision Map

It is an accepted practice that a decision map is beneficial toward expediting a sound decision to ignite a blowing well. However, a decision map alone is not adequate and must be supplemented by the knowledge and expertise of an experienced FIFI and well control expert, if at all possible. A generic decision map is shown in Figure E.2.

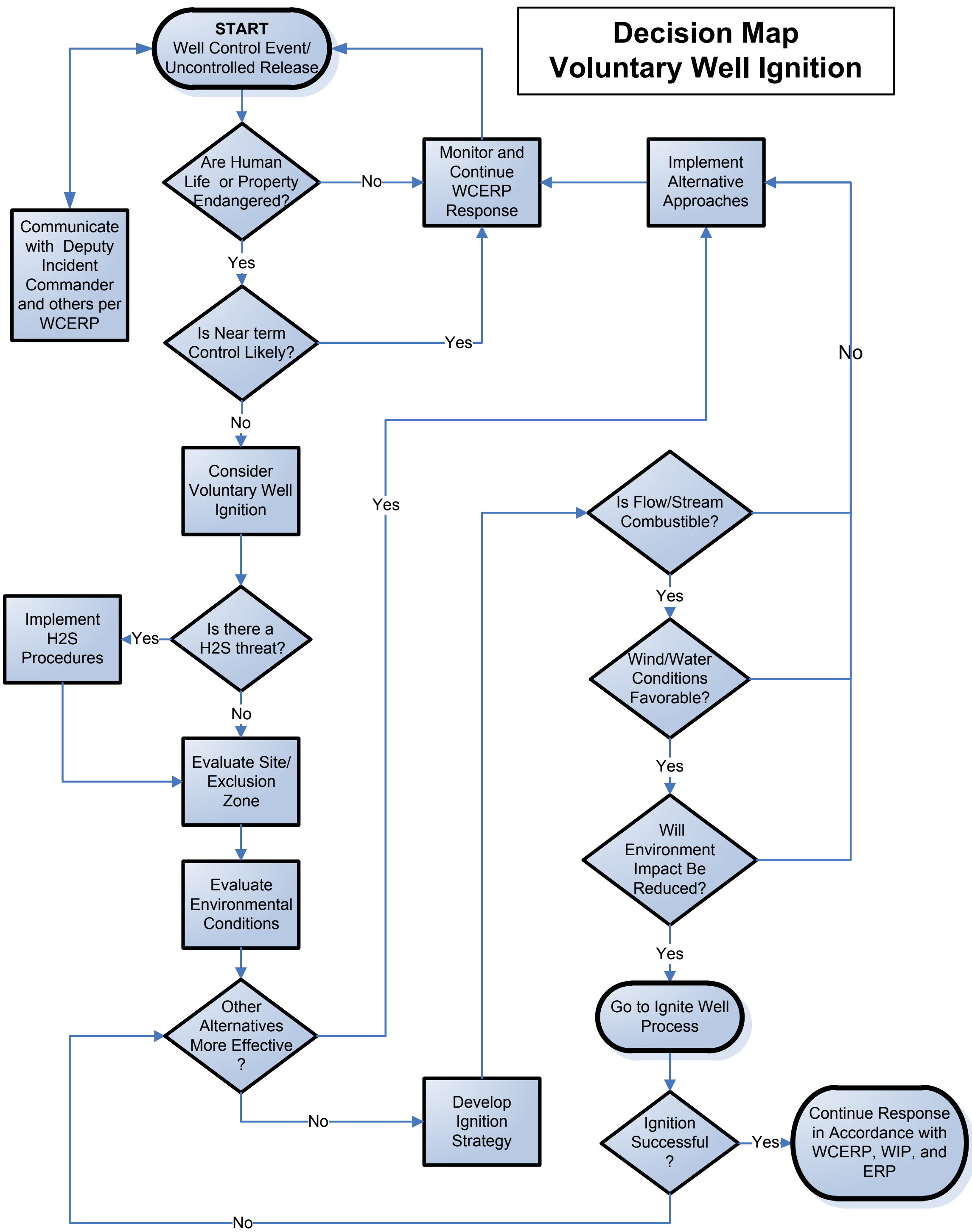

Figure E.2 – Decision Map

CONDITIONS AFFECTING WELL IGNITION

The decision to ignite a blowing gas/oil well must have all factors considered before a decision for voluntary ignition of the well can be made. Because most drilling sites are in remote areas and accessibility for heavy well control equipment can be an issue, the almost certain destruction of the drilling rig upon well ignition will prolong the well control event. The WIP should establish actions to be taken if a product release occurs while personnel are on site and should indicate the qualified Company representatives at the site who have the authority to ignite the release. These emergency response procedures should be reviewed as part of the prejob safety meeting. The conditions affecting well ignition are extensive. A more extensive analysis of some of the most important factors that might impact a decision to ignite a well is addressed in the tables at the end of this document. The following list identifies some of the elements for consideration, as each well event must be treated as unique.

- Does the well contain H_2S? If H_2S is present, in what concentrations?
- Are there any residential areas with hospitals, schools, or highly traveled roads close by?
- Igniting the well can cause serious damage to surrounding equipment, rendering it useless. It must be assumed that well ignition will remove the ability for operators to control the well. Collateral damage from the explosion might make the wellhead inaccessible.
- Equipment exposed to the ignition sequence might cause an equal or greater hazard. Always assess secondary explosion possibilities.
- Flammable liquid characteristics of the product released from the well might not be within the flammable range necessary for ignition. After ignition, maintaining the fire at the source might not be possible. Other products such as sulfur dioxide or water entrained in the fuel mixture might cause incomplete or lack of combustion conditions.
- What will be the efficiency of the burn? Will meaningful amounts of gas/oil be consumed in an effective effort to reduce the impacts of the well control event?
- Products of complete and incomplete combustion might create a secondary hazard within the range of the plume cloud.
- Are large amounts of gas/oil being produced?

- Are there any low-lying areas where gas/oil can accumulate?
- What is the general terrain in the affected area?
- What is the wind direction and speed?
- Is the area "footprint" increasing due to wind or wave action?
- Are there any lakes, oceans, rivers, or streams that can be affected by a spill?
- Are there any structures, production facilities, wells, or pipelines that can be affected?
- Is any wildlife affected by the gas/oil released?

In general, voluntary ignition of the well should NOT be done when any of the following is true:

- Well flow composition will not sustain ignition.
- There is a high probability of a rapid, successful intervention by a Well Control Specialist
- The nature of the blowout indicates a low rate of flow.
- A high tendency for the well to bridge exists.
- Potential for incident escalation is low.
- Concentration of H_2S is low.
- Pollution is easily contained and minimized.
- Isolation of failed equipment is possible.

VOLUNTARY IGNITION DRAWBACKS

The combustion efficiency of an ignited blowing gas/oil well cannot be forecast. Efficiencies might be as low as 50%–60%, depending on how obstructive the drilling rig is to the supply of oxygen needed to sustain the burn. This lower efficiency, coupled with a longer time to regain control or cap the well after ignition, might result in as much or more of an oil spill.

The nature and characteristics of the well control event are a major factor in making the determination to ignite the well, in addition to the presence of H_2S. It is important to note that not all wells should be ignited, including some H_2S wells. Some examples of wells that might be better controlled without ignition include the following:

- Equipment, flange, or other leak types that might be controlled by pumping junk shots or other methods
- Blowouts of the drill pipe, where the flow exit point is of benefit to effective gas dispersion
- Low-rate blowouts that might be controlled by momentum kills
- Some subsurface blowouts and ruptures

Alternatives to Required Ignition

- Grade (topographical contouring with connecting drainage ditches) the surface of the well site to channel and direct the flow of oil discharged and water down to sumps to prevent a large fraction of the oil from contaminating a larger area.
- Equip the sumps with suction pumps to move the collected oil to flare booms or burn pits.
- Expand the footprint of the well site to provide a larger sump for collection of the oil that rains back down on the location.
- Use a water cannon to knock oil out of the blowing plume.
- Employ additional well control equipment (added redundancy) to significantly reduce the probability of an uncontrolled flow, perhaps in the form of an extra blind-shearing ram placed on the wellhead below the normal BOP stack, and operated by its own independent control system.
- Use a more conservative well design, to include increased casing burst strength values.
- Divert the well flow to a pit a distance away from the rig and ignite the pit, not the well.

If, after consideration of the alternative approaches, the highest interests are best addressed by voluntary ignition of the well, proceed to ignite the well as safely and quickly as possible.

Options for Minimization of Collateral Damage

- Installation of blast shields
- Installation of thermal protection (reflective metal)
- Installation of deluge systems
- Development of a drainage system to channel oil away from the vicinity of the source flow, all adjacent wellheads, and production facilities
- Minimization of the time required to reach a decision to ignite such that the accumulation of gas/oil in and around adjacent wells and production facilities is minimized

Postignition Effects

Postignition effects from the ignition and subsequent fire should be considered as part of the WIP development process and during the execution of the plan. Among the most common effects are as follows:

- Secondary explosions that can occur at any time but usually shortly after the well's ignition
- Heat radiation that can harm persons near the fire
- Debris field caused by fire and explosion
- Need for air-quality monitoring
- Additional isolation procedures necessitated by changes in the dynamics of the well fire, environmental or other conditions

These effects should be anticipated and mitigated wherever possible.

SECONDARY EXPLOSIONS

Secondary explosions are almost assured during a rig fire. Numerous items on rigs can be subjected to sufficient heat that causes them to explode. Accumulator bottles, oxygen-acetylene cutting equipment, diesel tanks, perforating charges, and other common oilfield explosives, production separators and other production equipment, can all be dangerous when a well is on fire. Thus, it is important to allow the situation to stabilize before making an assessment after ignition. Gas accumulation inside rig structures is very dangerous. If this gas is not ignited, radiant heat and fire impinging on the structure can cause the gas inside to explode or ignite.

HEAT RADIATION

Fires produce radiant heat (thermal radiation) that can result in burns to exposed personnel. A thermal radiation level of concern is the threshold level above which a hazard might exist. The thermal radiation effects that individuals might experience depend primarily upon the length of time that individual is exposed to a specific thermal radiation level. Longer exposure durations, even at a lower thermal radiation level, can produce serious physiological effects. Figure E.3 lists some of the effects of thermal radiation exposure on bare skin at specific levels and durations. ALOHA's default thermal radiation values are based on a review of widely accepted sources (American Institute of Chemical Engineers 1994, Federal Emergency Management Agency et al. 1988). Three threshold values (measured in kilowatts per square meter and denoted as kW/m^2) have been calculated using ALOHA:

- 10 kW/m^2 (potentially lethal within 60 sec)
- 5 kW/m^2 (second-degree burns within 60 sec)
- 2 kW/m^2 (pain within 60 sec)

In a stable, uniform, and symmetrical fire, the heat flux could be expected to extend uniformly in a circular pattern away from the source. However, thermal radiation from the fire can be greatly affected by the several factors. Direction of the fire and resulting heat flux will be impacted from the debris and remains of the rig and site structures, specific failure points on the wellhead, piping, or other equipment. Weather is also a significant factor influencing the radiant heat density as it is evident that strong winds will tend to skew the heat flux downwind.

Radiation Intensity (kW/m^2)	Time for Severe Pain (Seconds)	Time for Second-Degree Burns (Seconds)
1	115	663
2	45	187
3	27	92
4	18	57
5	13	40
6	11	30
8	7	20
10	5	14
12	4	11

Figure E.3 – Thermal Radiation Burn Criteria
Source: US EPA and NOAA (2007).

Debris Field Created by Fire/Explosion

Most rig fires create significant debris, removal of which can be a lengthy process, increasing the well control time in almost every event. The quantity of debris to remove is directly related to the operational environment. Onshore production fires usually have less debris to remove than offshore drilling rig fires. Residual chemicals used around a well or rig can be very flammable and hazardous. In addition, radioactive materials, such as those found in logging equipment, can also be a special hazard if subjected to fire. Workers at the well must take necessary precautions when dealing with all kinds of these potentially hazardous materials and debris.

Air Quality Monitoring

The WIP should also outline procedures for acquiring and deploying additional monitoring and air quality equipment, if required. After ignition, much of the H_2S should be converted to sulfur dioxide. While typically less dangerous that H_2S, sulfur dioxide at levels that exceed 10 ppm should require all persons to be evacuated to a safe location.

Additional Isolation Procedures

The Company might have to deal with the problem of isolating a major highway or railway if the hazard has the potential to impact the traveling public or railway operations. The Company's Emergency Response Plan should identify the highways and railways that could be affected and set out the procedures for communicating with the regional and local transportation authorities, regulatory agencies, and appropriate rail companies to isolate the area.

Well Ignition Procedure

Since every blowout is different, the absolute procedure for igniting a well cannot be written for every possible circumstance. When the decision to ignite the well has been made, the swell must be ignited quickly but with the utmost care and safety. A generic procedure for igniting the well is shown below in Figure E.4. A detailed checklist of voluntary ignition procedures for field use is shown at the end of this appendix.

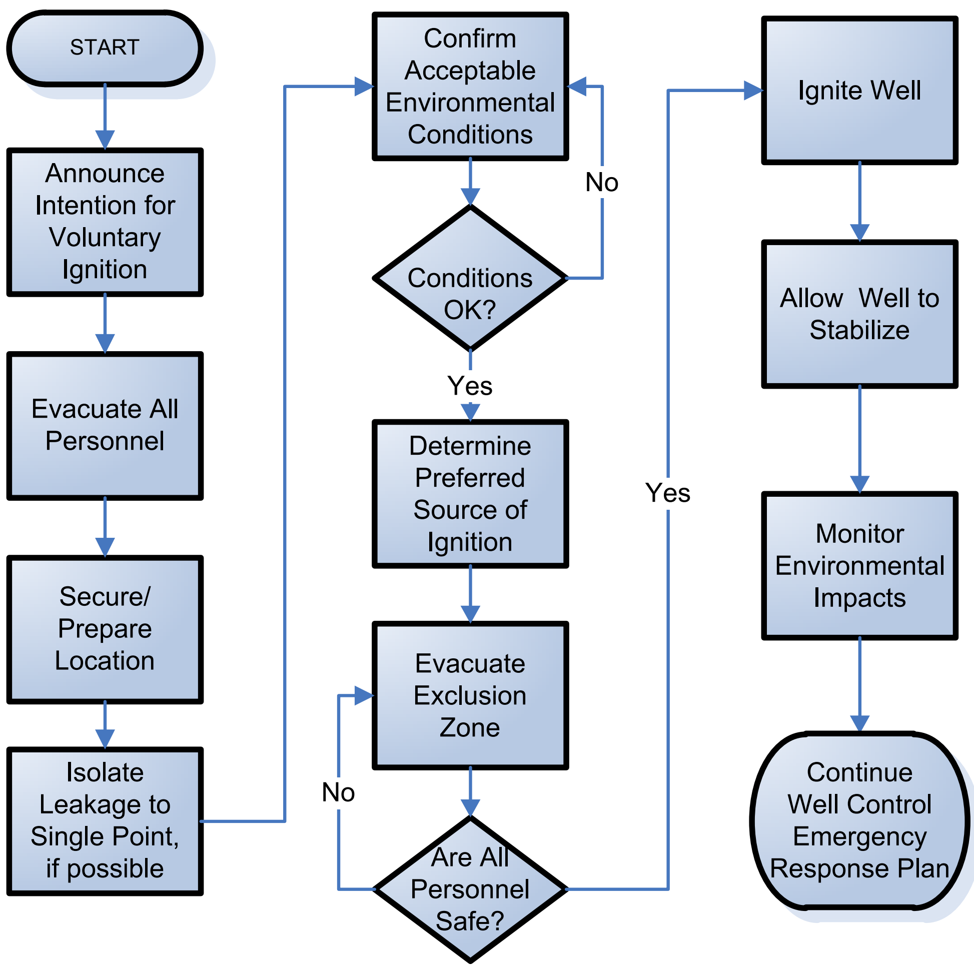

Figure E.4 – Well Ignition Procedure

Certain procedures should be completed for most situations, in order to safely ignite the flow. When the order to ignite a well is given, these guidelines should be followed:

- Evacuate all personnel.
- Rescue injured personnel.
- If possible, limit the blowout's exit point to a single source through methods such as closing BOP stack valves, tree and wellhead valves, and chokes.
- Evaluate wind and weather conditions to ascertain whether the situation might endanger remaining personnel or the person responsible for igniting the well.
- Determine whether ignition by way of a flare gun or other tool is possible from the facility: Strong prevailing winds away from the firing point, H_2S-free atmosphere, available cover from a flashback, and clear escape access.
- Establish the flare gun's range and whether well access within this range is safe and possible, given the presence of H_2S and potential heat radiation.
- Clear all personnel and local residents within a 1-mile radius, except for personnel required at the firing base. Evacuation zones should always be located upwind and determined to be a minimum of 1 mile or at a 0-percent LEL, whichever is greater. The radius might have to be expanded, depending on the well's flow rate and the H_2S concentration and dispersal patterns. A potential range for this distance should be determined whenever H_2S contingency and well ignition plans are written, however, the actual conditions will dictate the proper distance.
- Potential overpressure from a gas cloud explosion can be calculated using several different methods. The WIP can include calculations for different vapor clouds, so that decisions can be made that could influence the ignition procedure and the distance required to safely light the well.
- To ignite the well, approach from the upwind side while monitoring H_2S levels. While remaining within a safe area and with the range of the ignition device, a single person should fire the tool and ignite the flow. Escape from the area should be made immediately, due to possible secondary explosions and falling debris.
- Once ignition takes place, the well should not be approached until it stabilizes. Later conditions should permit access with reasonable safety while under the strict supervision of Well Control Specialists.

REFERENCES

API RP68, *Recommended Practice for Oil and Gas Well Servicing and Workover Operations Involving Hydrogen Sulfide*.

ERCB Directive 071, *Emergency Preparedness and Response Requirements for the Petroleum Industry*.

WELL IGNITION FIELD CHECK SHEET

Site: ______________________________ Date: ______________

Company Man: ______________________________

Step	Activities	Completed by: (Name/Title)
Announce Intention for Voluntary Ignition	• Alert all personnel that the well will be ignited. • Advise local authorities and others per WCERP.	____________ ____________
Evacuate All Personnel	• Evacuate any injured or disabled personnel. • Evacuate all nonessential personnel. • Begin evacuation of nearby residences/others. Evacuation zones are located upwind and determined to be a minimum of 1 mile or at 0% vapor LEL, whichever is greater.	____________ ____________
Secure/Prepare Location	• As possible and if safety of personnel can be assured, secure and prepare site to facilitate control of the well. — Remove any radioactive logging equipment, specialty, or other hazardous materials from the site, if possible. — Prepare/enhance dikes, berms, or channels that might be used to direct liquid or material flows. — Anticipate drainage of FIFI consumables. — Remove materials that might result in secondary explosions. — Anticipate and prepare for a controlled destruction of rig and equipment that will facilitate future well control (provide fire protection/cooling on two legs of rig so that rig failure will result in rig falling away from future approach to well).	____________ ____________
Isolate Leakage	• Isolate leakage to one source of discharge, if possible. Consider the preferred direction of discharge if multiple options exist.	____________ ____________
Confirm Acceptable Environmental Conditions Are Present	• Confirm that acceptable environmental conditions are present to perform a safe ignition. — Low to moderate wind speed — Other factors as appropriate	____________ ____________

Step	Activities	Completed by: (Name/Title)
Determine Preferred Source of Ignition	• Determine the preferred source of ignition. — Flare gun — FireFly™ Remote/Auto System — Other ignition methods, as available • Ensure the range of the equipment is sufficient using the safest direction of approach. • Deploy a strategy to ensure ignition will be sustained, if flammability of stream is not consistent.	____________________ ____________________
Evacuate Exclusion Zone	• Evacuate everyone from the impacted area except for the person or persons igniting the well. • Plan for the maximum overpressure that could be experienced due to a gas cloud explosion. • Are all persons safe and accounted for?	____________________ ____________________
Ignite Well	• Approach the well from an upwind direction. • Ensure that only one person, appropriately qualified, operates the ignition equipment. — Name:____________________________ • Ignite the well using the selected ignition method. — Time: ______ Other Comments: ________________________________ ________________________________ ________________________________ ________________________________ • Evacuate immediately to safe range. Inform Company Man of successful evacuation.	____________________ ____________________
Allow Well to Stabilize	• Allow the well fire to stabilize. • Prepare for the potential of any secondary explosions. • Ensure ignition is sustained. • Anticipate, monitor, and mitigate postignition effects, as possible. • Consult Well Control Specialist for ongoing direction.	____________________ ____________________

Step	Activities	Completed by: (Name/Title)
Monitor Environmental Impacts	• Monitor environmental impacts, as appropriate. — H_2S or SO_2 — Air — Pollution/Water — Others • Take appropriate action such as the following: — Modification of exclusion zone shape or size in reaction to sensors and hazard levels to ensure the safety of all persons	____________ ____________
Continue Well Control Emergency Management Plan	Continue to operate in accordance with the Well Control Emergency Response Plan.	

APPENDIX F – INTERVENTION EQUIPMENT LIST

This section outlines some of the equipment that might be needed for a variety of well control intervention projects. Most of the specialized intervention equipment and materials will come from sources along the United States Gulf Coast. This type of equipment is usually built to be easily transported by airfreight and can be deployed relatively quickly to any location worldwide.

SPECIALIZED FIREFIGHTING EQUIPMENT

A minimum of two 4,000 gpm, 500 HP pumps is usually required. The necessary hardware to use either earth pits or frac tanks for suction supply will be required. For this particular application, at least one transfer pump might be required to replenish the water reservoir.

Typically, four 750 to 1,000 gpm adjustable water monitors are used. A variety of other sizes are available for particular applications.

Figure F.1 – 4,000 gpm Firefighting Pump

Rated at 4,000 gpm, the FIFI pumps are equipped with an 8V92TA Detroit Diesel engine coupled to a L8R20 Worthington pump. These pumps are all skid-mounted for easy mobilization. Figure F.1 above illustrates a FIFI pump with a capacity of 4,000 gpm.

Pump and Fuel Tank Specifications

Item	Description	Weight	Dimensions
1.	4,000 gpm Fire Pump	10,060 lb Dry 11,260 lb Wet	L: 13' x W: 5' x H: 6' 9"
2.	500 gal Fuel Tank	2,900 lb Dry 6,640 lb Wet	L: 8' x W: 4' 9" x H: 6'

Hydro-Chem Monitor Stand (2,000 gpm)

A "Hydro-Chem" monitor is used to support well control operations where flammable liquids are present. This specialized piece of equipment is also used on ship fires and in petrochemical facilities.

Figure F.2 – 2,000 gpm Hydro-Chem Monitors

General Equipment

Construction Equipment

There are a number of items that can be considered standard construction-type equipment. This type of equipment is often used in oilfield and well control operations.

Fabrication Personnel and Equipment

Skilled welders will be needed for various fabrication projects. Each should be supplied with necessary equipment such as welding machines, cutting torches, grinders, chipping hammers, and wire brushes. An adequate supply of safety equipment ordinarily used during fabrication projects such as goggles and face shields will be required (typical requirement: 6–8, possibly more).

Roustabouts

A roustabout crew will be needed for various tasks such as fabrication and rig up of pumps and lines. A crew consisting of one supervisor and five roustabouts should be contracted.

Material

A considerable amount of fabrication material might be needed for various tasks. The material list will include items needed to build heat shields, fire monitor enclosures, and capping accessories, and other items:

- 500 sheets of 2' x 8' galvanized corrugated tin (10 gauge)
- 50 joints of $2^{3}/_{8}$" tubing
- 24 pieces (500 ft^2) of expanded metal grating
- 750 ft of 2" x 2" x ¼" angle iron
- 500 ft of 3" x 3" x ¼" angle iron
- 4 sheets of 4' x 8' x ¼" steel plate
- 250 ft of ½" cold rolled bar

Air Compressor

Two 185 cfm, 125 psi air compressors, each with a minimum of 150 ft of 2" 300 psi WP hose and spare end connections. These will be required to supply air for starting pumps and operating pneumatic tools that might be needed for the project. Air compressors are generally available through local specialty rental companies or might be available on the primary support vessel.

Generators

Self-contained diesel-powered generators might be required in order to power certain electrical equipment (typical requirement: 1–2).

Light Towers

Self-contained diesel-powered light towers should be ordered to facilitate fabrication projects that might extend into the night. Light plants and towers are generally available from specialty rental or construction companies. The primary support vessel might have adequate lighting.

Pneumatic Tools

Impact wrenches, drills, grinders, and pneumatic hacksaws along with hoses, sockets, bits, and various other accessory pieces are included in this type of equipment. These are available from most oilfield supply or construction outlets.

Pneumatic Winches

Large pneumatic winches, or “air tuggers,” might be needed for capping or debris removal. They are usually available through specialty rental companies.

Special Well Control Equipment

Coiled Tubing Units

There might be a need for a coiled tubing unit during the intervention. The size of the coiled tubing varies from 1" to as much as 3½". In addition to the size of the tubing itself, the pressure rating of the equipment must also be considered. Most coiled tubing units are rated to 10,000 psi working pressure. However, there are a limited number of 15,000 psi working-pressure units in use in various locations.

Snubbing Equipment

Snubbing units are often used in well control operations. The units are sized according to the lift rating of the hydraulic snubbing jack. The particular size of the unit needed depends on the particular job. The basic sizes of snubbing units are 150K, 240K, 340K, 460K, and 600K. The snubbing capacity is generally one half of the lifting capacity of the jack. The ancillary equipment required for snubbing includes a minimum of stripping ram BOPs with an equalizing loop and bleed off. Various pump lines and manifolds are also required for snubbing operations. The snubbing jacks, power packs, and other items are available through several specialty snubbing vendors.

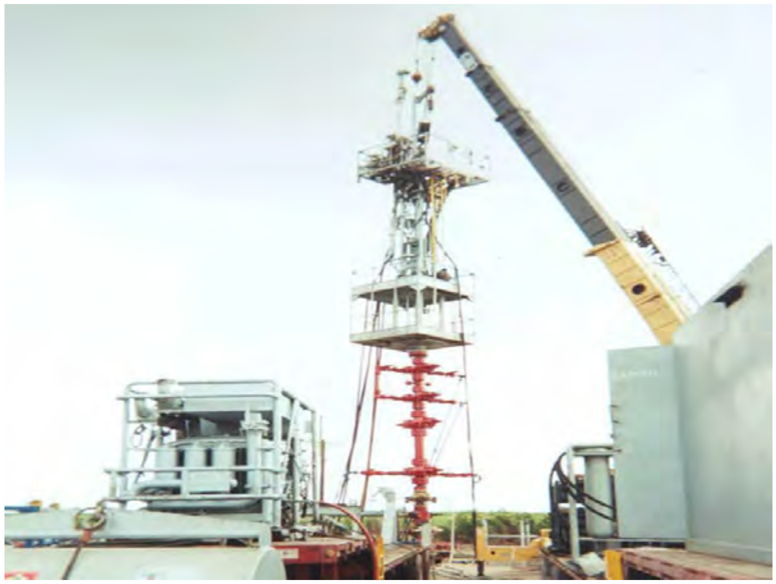

Figure F.3 – Snubbing Equipment

Hydraulic Tongs

These tongs usually are different from standard casing tongs in that they have backup built into them. The tongs might be required to make or break drill pipe or drill collars and thus will need to have high torque capabilities. These tongs are available through specialty tong vendors or casing crew companies.

Hydraulic Tools

This equipment includes tools such as torque wrenches, nut splitters, and portable power jacks. These are available from pressure-testing companies and specialty rental companies.

Hot-Tapping and Valve Drilling Equipment

There might be a requirement for hot-tap and valve drilling equipment. This equipment is used to drill into a pressurized pipe or vessel. Valve drilling equipment is used to drill through the gate on a damaged gate valve. Hot-tap and valve drilling equipment is available through WWCI and other oilfield service companies. The following picture shows the hot-tap tool in use on a well control job.

Figure F.4 – Hot Tap Tool

Mud Mixing Equipment

There might be a requirement for a full complement of mud-mixing equipment to prepare kill fluids. This includes mud tanks, mixing hoppers, bulk materials storage equipment, and materials-handling equipment.

Abrasive Jet Cutters

High-pressure cutters that use abrasive material such as frac sand, slag, or crushed garnet might be needed for debris or wellhead removal. These cutters can be used in explosive atmospheres. The cutters are available from WWCI, BJ Services, and Halliburton.

Figure F.5 – Abrasive Jet Cutter

Proximity Ranging Equipment

In a relief well situation, magnetic ranging tools might be needed to locate the blowout well. The company that provides this type of service is located in the US state of New York. This equipment is easily transported by airfreight.

Breathing Equipment

If toxic gas is present or heavy accumulations of hydrocarbon gases are in the area, breathing equipment and trained personnel should be on site at all times. A cascade breathing system should be installed on the primary support vessel adequate to provide air for all personnel. An ample supply of portable air packs, both 30-minute and 5-minute "escape packs," should be available consistent with the number of personnel onboard. Spare masks, regulators, and bottles should be available on site. A breathable-air compressor should be placed on the primary support vessel to recharge the bottles and cascade system.

A gas-monitoring system might be needed. This should include visual and audible alarms, a 6-channel monitoring system and a battery backup. Several portable gas detectors will also be needed.

Lathe Cutters

Portable, lathe-type die cutters might be required for circumferential cuts on casing strings. The cutters can be either pneumatic or hydraulic depending on the application. These cutters come in a variety of sizes and are available through WWCI and other oilfield service companies.

Figure F.6 – Lathe Cutter in Use on 5" Drill Pipe

Freeze Equipment

There are two types of freezes done in well control applications. The older type is a dry-ice freeze. The equipment and materials required to perform this type are dry ice (CO_2), methanol, a bucket, and a liner. The bucket is usually fabricated for the specific item that is to be frozen. Dry ice and methanol are available through various commercial outlets. The newer and more efficient method is to use a prefabricated jacket for the pipe size and liquid nitrogen to freeze. The kit generally includes coils and blankets or special jackets that fit around the pipe that is to be frozen.

Figure F.7 – Freeze Operation

OTHER SPECIALIZED EQUIPMENT

The list of specialty surface and downhole equipment that is used in well control intervention is very long. In addition to the equipment listed above, landing nipples and plugs, back-pressure valves, shot drums, windows for coiled tubing or snubbing units, casing and tubing clamps, slip rams, punch rams, cutter rams, antirotation rams, stripper rams, cables, snatch blocks, and a host of other assorted items might be needed for the intervention. This gear is available through WWCI, BTI, and various other specialty oilfield companies.

APPENDIX G – AIR MONITORING REQUIREMENTS

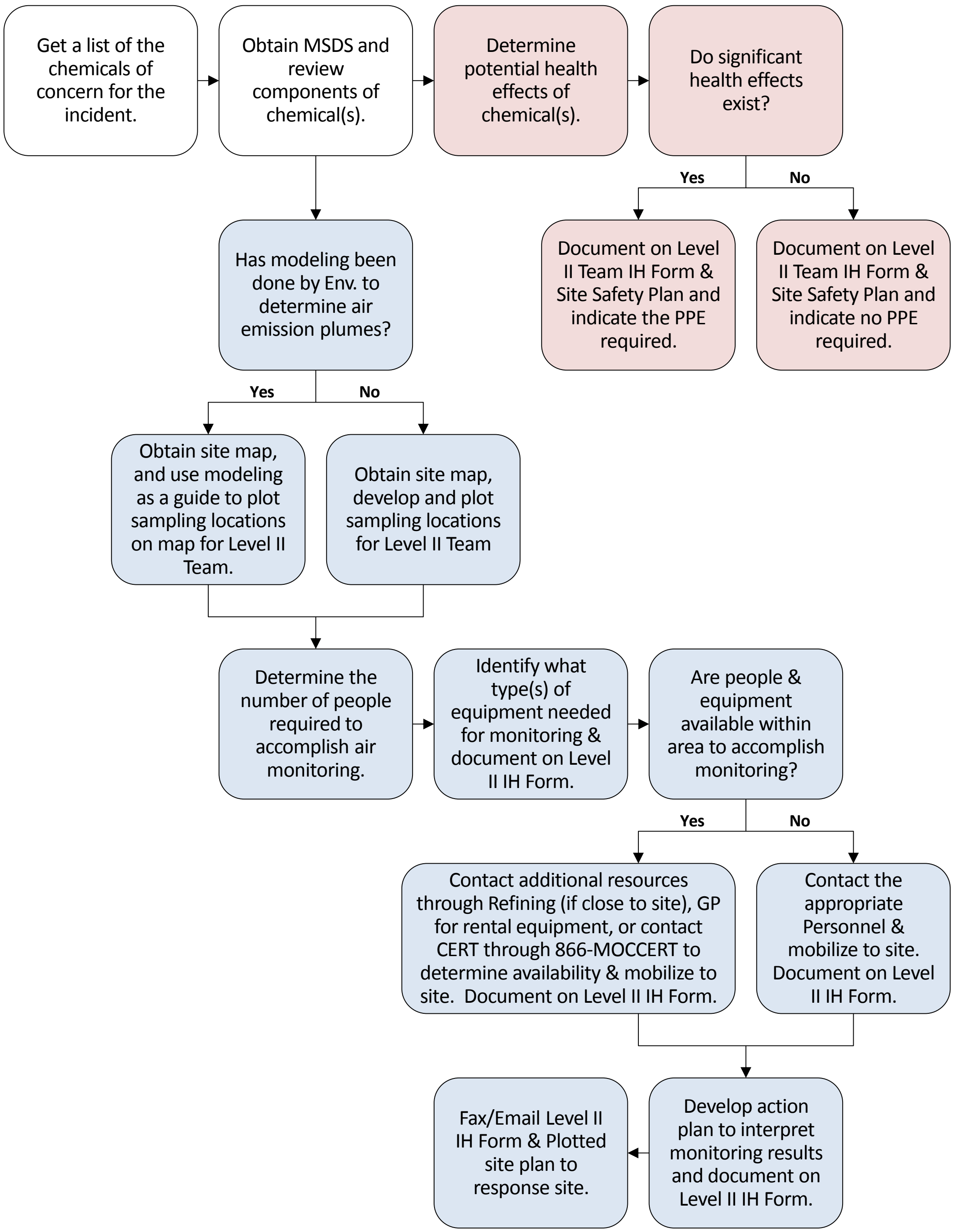

Figure G.1 – Air Monitoring Decision Flowchart

IH Air Monitoring Information Form for Level II Team

Products of Concern
Product Components of Concern
Probable Exposure Health Effects of Product
PPE Required
Number of People Required to Monitor (Including Names and Organization)

Equipment Needed to Monitor (Including Where Equipment Is Coming from)
Monitoring Locations
See site plan with marked monitoring locations.
Monitoring Results Action Plan

Level II Response Air Monitoring Log

Sampler Name:	**Date:**	**Facility Name:**
Monitoring for:	**Equipment Used:**	
	☐ Direct Reading ☐ Detector Tubes ☐ Other	
For Direct Reading Equipment:	**For Detector Tubes:**	**For Other:**
Manufacturer and Model: ____________ Serial Number: ____________ Calibration Date: ____________	Manufacturer: ____________ Tube Type: ____________ Tube Range: ____________	Describe Monitoring Equipment:
MONITORING RESULTS		
Location	**Time (Include "a.m." or "p.m.")**	**Reading (Include Units)**

APPENDIX H – LOCAL RESPONDER INFORMATION

FIRE/FIRST RESPONDER

Fire and first-responder responsibilities include the following:

- Perform a site assessment.
- Perform air monitoring.
- Remove accessible casualties to a safer zone.
- Decontaminate, as necessary.
- Triage, treat, and transport casualties.
- Establish site access and accountability.
- Assure that a well control company has been notified.
- Prevent expansion of any fire.
- Perform initial interventions to prevent runoff of contaminants.
- Assist with evacuation, as necessary.
- Preserve evidence, when possible.

EMERGENCY MEDICAL SERVICES

- Assure site safety.
- Establish that air monitoring is in place and area is safe before entry, where appropriate.
- Remove accessible casualties to a safer zone.
- Decontaminate, as necessary.
- Triage, treat, and transport casualties.
- Establish a dedicated unit for the safety of incident responders.
- Assist with evacuation, as necessary.

Law Enforcement

- Control access to the site.
- Consider the cause of the incident.
  - Accident within the normal scope of work processes
  - Accident outside the normal scope of work processes
  - Intentional act of sabotage
- Work with responders to preserve evidence, when possible.
- Execute traffic plan.
- Assist with evacuations, as necessary.

Emergency Management

- Activate Emergency Management plan as necessary based on size and scope of incident.
- Assure that a Well Control Company has been notified.
- Support the activities of the Incident Commander, as needed.
- Consider the health effects of gas cloud or products of combustion downwind from incident.
  - Old and young populations
  - Populations with preexisting conditions likely to be exacerbated
  - Populations with limited mobility (hospitals, nursing homes, senior living centers, jails)
  - Special-needs populations
  - Limited access to transportation