# APPENDIX K: DEPARTMENT OF INTERIOR'S ONSHORE OIL AND GAS ORDER NUMBER 2, SECTION III.G., DRILLING ABANDONMENT

**BUREAU OF LAND MANAGEMENT**
**43 CFR 3160**

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**Onshore Oil and Gas Operations; Federal and Indian Oil and Gas Leases; Onshore oil and Gas Order No. 2, Drilling Operations**



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## Onshore Oil and Gas Order No. 2
## Drilling Operations on Federal and Indian Oil and Gas Leases

## I. Introduction

### A. Authority

This order is established pursuant to the authority granted to the Secretary of the Interior pursuant to various Federal and Indian mineral leasing statutes and the Federal Oil and Gas Royalty Management Act of 1982. This authority has been delegated to the Bureau of Land Management and is implemented by the onshore oil and gas operating regulations contained in 43 CFR Part 3160. Section 3164.1 thereof specially authorizes the Director, Bureau of Land Management, to issue Onshore Oil and Gas Orders when necessary to implement and supplement the operating regulations and provides that all such Orders shall be binding on the lessees and operators of Federal and restricted Indian (except Osage tribe) oil and gas leases that have been, or may hereafter be issued.

Specific authority for the provisions contained in this Order is found at: 3162.3-1 Drilling Applications and Plans; 3162.3-4 Well Abandonment; 3162.4-1 Well Records and Reports; 3162.4-3 Samples, Tests, and Surveys; 3162.5-1 Environmental Obligations; 3162.5-2 Control of Wells; 3162.5-2(a) Drilling Wells; 3162.5-3 Safety Precautions; and

**B. Purpose**

This Order details the Bureau's uniform national standards for the minimum levels of performance expected from lessees and operators when conducting drilling operations on Federal and Indian lands (except Osage Tribe) and for abandonment immediately following drilling. The purpose also is to identify the enforcement actions that will result when violations of the minimum standards are found, and when those violations are not abated in a timely manner.

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**C. Scope**

This Order is applicable to all onshore Federal and Indian (except Osage Tribe) oil and gas leases.

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**D. General**

1. If an operator chooses to use higher rated equipment than that authorized in the Application for Permit to Drill (APD), testing procedures shall apply to the approved working pressures, not the upgraded higher working pressures.

2. Some situations may exist either on a well-by-well or field-wide basis whereby it is commonly accepted practice to vary a particular minimum standard(s) established in this Order. This situation may be resolved by requesting a variance (See section IV of this Order), by the inclusion of a stipulation to the APD, or by the issuance of Notice to Lessees and Operators (NTL) by the appropriate BLM office.

3. When a violation is discovered and if it does not cause or threaten immediate substantial and adverse impact on public health and safety, the environment, production accountability or royalty, it will be reissued as a major violation if not corrected during the abatement period and continued drilling has changed the adverse impact of the violation so that it meets the specific definition of a major violation.

4. This Onshore Order is not intended to circumvent the reporting requirements or compliance aspects that may be stated elsewhere in Existing NTL's, Onshore Orders, etc. A lessee's compliance with the requirements of the regulations in this Part shall not relieve the lessee of the obligation to comply with other applicable laws and regulations in accordance with 43 CFR 3162.5-1(c). Lessee's should give special attention to the automatic assessment provisions in 43 CFR 3163.1(b).

5. This Order is based upon the assumption that operations have been approved in accordance with 43 CFR Part 3160 and Onshore Oil and Gas Order No.1. Failure to obtain approval prior to commencement of drilling or related operations shall subject the operator to immediate assessment under 43 CFR 3163.1(b)(2).

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## II. Definitions.

A. Abnormal Pressure Zone means a zone that has either pressure above or below the normal gradient for an area and/or depth.

B. Bleed Line means the vent line that bypasses the chokes in the choke manifold system; also referred to as Panic Line.

C. Blooie Line means a discharge line used in conjunction with a rotating head. D. Drilling Spool means a connection component with both ends either flanged or hubbed with an internal diameter at least equal to the bore of the casing, and with smaller side outlets for connecting auxiliary lines.

E. Exploratory Well means any well drilled beyond the known producing limits of a pool.

F. Filled-up Line means the line used to fill the hole when the drill pipe is being

removed from the well. It is usually connected to a 2-inch collar that is welded into a drilling nipple.

G. Flare Line means a line used to carry gas from the rig to be burned at a safer location. The gas comes from the degasser, gas buster, separator, or when drill stem testing, directly from the drill pipe.

H. Functionally Operated means activating equipment without subjecting it to well-bore pressure.

I. Isolating means using cement to protect, separate, or segregate usable water and mineral resources.

J. Lease means any contact, profit-share agreement, joint venture, or other agreement issued or approved by the United States under a mineral leasing law that authorizes exploration for, extraction of, or removal of oil or gas (See 43 CFR 3160.0-5).

K. Lessee means a person holding record title in a lease issued by the United States (See 43 CFR 3160.0-5).

L. Make-up Water means water that is used in mixing slurry for cement jobs and plugging operations, and is compatible with cement constituents being used.

M. Manual Locking Device means any manually activated device, such as a hand wheel, etc., that is used for the purpose of locking the preventer in the closed position.

N. Mud for Plugging Purposes means a slurry of bentonite of similar flocculent/viscosfer, water, and additive needed to achieve the desired weight and consistency to stabilize the hole.

O. Mudding Up means adding materials and chemicals to water to control the viscosity, weight, and filtrate loss of the circulating system.

P. Operating Rights Owner (or Owner) means a person or entity holding operating rights in a lease issued by the United States. A lessee also may be an operating rights owner if the operating rights in a lease or portion thereof have not been severed from record title.

Q. Operational means capable of functioning as designed and installed without undue force or further modification.

R. Operator means any person or entity , including but not limited to the lessee or operating rights owner, who has stated in writing to the authorized officer his/her responsibility for the operations conducted in the leased lands or a portion thereof.

S. Precharge Pressure means the nitrogen pressure remaining in the accumulator after all the hydraulic fluid has been expelled from beneath the movable barrier.

T. Prompt Correction means immediate correction of violations, with drilling suspended if required in the discretion of the authorized officer.

U. Prospectively Valuable Deposit of Minerals means any deposit of minerals that the authorized officer determines to have characteristics of quantity and quality that warrant its protection.

V. Tagging the Plug means running in the hole with a string of tubing or drill pipe and placing sufficient weight on the plug to insure its integrity. Other methods of tagging the plug may be approved by the authorized officer.

W. Targeted Tee or Turn means a fitting used in pressure piping in which a bull plug or blind flange of the same pressure rating as the rest of the approved system is installed at the end of a tee or cross, opposite the fluid entry arm, to change the direction of flow and to reduce erosion.

X. 2M, 3M, 5M, 10M, and 15M mean the pressure ratings used for equipment with a working pressure rating of the equivalent thousand pounds per square inch (psi) (2M=2,000 psi, 3M=3,000 psi, etc.)

Y. Usable Water means generally those waters containing up to 10,000 ppm of total dissolved solids.

Z. Weep Hole means a small hole that allows pressure to bleed off through the metal plate, used in covering well bores after abandonment operations.

[57 FR 3025, Jan. 27, 1992]

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## Requirements

### A. Well Control Requirements

1. Blowout preventer (BOP) and related equipment (BOPE) shall be installed, used, maintained, and tested in manner necessary to assure well control and shall be in place and operational prior to drilling the surface casing shoe unless otherwise approved by the APD. Commencement of drilling without the approved BOPE installed, unless otherwise approved, shall subject the operator to immediate assessment under 43 CFR 3163.1(b)(1). The BOP and related control equipment shall be suitable for operations in those areas which are subject to sub-freezing conditions. The BOPE shall be based on known or anticipated sub-surface pressures, geologic conditions, accepted engineering practice, and surface environment. The working pressure of all BOPE shall exceed the anticipated surface pressure to which it may be subjected, assuming a partially evacuated hole with a pressure gradient of 0.22 psi/ft.

2. The gravity of the violations for many of the well control minimum standards listed below are shown as minor. However, very short abatement periods in this Order are often specified in recognition that by continuing to drill, the violation which was originally determined to be of a minor nature may cause or threaten immediate, substantial and adverse impact on public health and safety, the environment, production accountability, or royalty income, which would require it reclassification as a major violation.

a. Minimum standards and enforcement provisions for well control equipment. i. A well control device shall be installed at the surface that is capable of complete closure of the well bore. This device shall be closed whenever the well is unattended.

Violation: Major.
Corrective Action: Install the equipment as specified.
Normal Abatement Period: Prompt correction required.

ii. 2M system:

- Annular preventer, or double ram, or two rams with one being blind and onebeing a pipe ram *
- kill line (2 inch minimum)
- 1 kill line valve (2 inch minimum)
- 1 choke line valve
- 2 chokes (refer to diagram in Attachment 1)
- Upper kelly cock valve with handle available
- Safety valve and subs to fit all drill strings in use
- Pressure gauge on choke manifold
- 2 inch minimum choke line
- Fill-up line above the uppermost preventer.

Violation: Minor (all items unless marked by asterisk).
Corrective Action: Install the equipment as specified.
Normal Abatement Period: 24 hours.

*Violation: Major.
Corrective Action: Install the equipment as specified.
Normal Abatement Period: Prompt correction required.

iii. 3M system:

- Annular preventers*
- Double ram with blind rams and pipe rams*
- Drilling spool, or blowout preventer with 2 side outlets (choke side shall be a 3-inch minimum diameter, kill side shall be at least 2-inch diameter)*
- Kill line (2 inch minimum)
- A minimum of 2 choke line valves (3 inch minimum)*
- 3 inch diameter choke line
- 2 kill line valves, one of which shall be a check valve (2 inch minimum)*
- 2 chokes (refer to diagram in Attachment 1)
- Pressure gauge on choke manifold
- Upper kelly cock valve with handle available
- Safety valve and subs to fit all drill string connections in use
- All BOPE connections subjected to well pressure shall be flanged, welded, or clamped*
- Fill-up line above the uppermost preventer.

Violation: Minor (all items unless marked by asterisk).
Corrective Action: Install the equipment as specified.
Normal Abatement Period: 24 hours.

*Violation: Major.
Corrective Action: Install the equipment as specified.
Normal Abatement Period: Prompt correction required.

iv. 5M system:

- Annular preventer*
- Pipe ram, blind ram, and, if conditions warrant, as specified by the authorized officer, another pipe ram shall also be required*
- A second pipe ram preventer shall be used with a tapered drill string
- Drilling spool, or blowout preventer with 2 side outlets (choke side shall be a 3-inch minimum diameter, kill side shall be at least 2-inch diameter)*
- 3 inch diameter choke line
- 2 choke line valves (3 inch minimum)*
- Kill line (2 inch minimum)
- 2 chokes with 1 remotely controlled from rig floor (refer to diagram in Attachment 1)
- 2 kill line valves and a check valve (2 inch minimum)*
- Upper kelly cock valve with handle available
- When the expected pressures approach working pressure of the system, 1 remote kill line tested to stack pressure (which shall run to the outer edge of the substructure and be unobstructed)
- Lower kelly cock valve with handle available
- Safety valve(s) and subs to fit all drill string connections in use
- Inside BOP or float sub available
- Pressure gauge on choke manifold
- All BOPE connections subjected to well pressure shall be flanged, welded, orclamped*
- Fill-up line above the uppermost preventer.

Violation: Minor (all items unless marked by asterisk).
Corrective Action: Install the equipment as specified.
Normal Abatement Period: 24 hours

*Violation: Major.
Corrective Action: Install the equipment as specified.
Normal Abatement Period: Prompt correction required.

v. 10M & 15M system:

- Annular preventer*
- 2 pipe rams*
- Blind rams*
- Drilling spool, or blowout preventer with 2 side outlets (choke side shall be a 3-inch minimum diameter, kill side shall be at least 2-inch diameter)*
- 3 inch choke line*
- 2 kill line valves (2 inch minimum) and check valve*
- Remote kill line (2 inch minimum) shall run to the outer edge of the substructure and be unobstructed
- Manual and hydraulic choke line valve (3 inch minimum)*
- 3 chokes, 1 being remotely controlled (refer to diagram in Attachment 1)
- Pressure gauge on choke manifold
- Upper kelly cock valve with handle available
- Lower kelly cock valve with handle available
- Safety valves and subs to fit all drill string connections in use
- Inside BOP or float sub available
- Wearing ring in casing head
- All BOPE connections subjected to well pressure shall be flanged, welded, orclamped*
- Fill-up line installed above the uppermost preventer.

Violation: Minor (all items unless marked by asterisk).
Corrective Action: Install the equipment as specified.
Normal Abatement Period: 24 hours.

*Violation: Major. Corrective Action:
Install the equipment as specified.
Normal Abatement Period: Prompt correction required.

vi. If repair or replacement of the BOPE is required after testing, this work shall be performed prior to drilling out the casing shoe.

Violation: Major.
Corrective Action: Install the equipment as specified.
Normal Abatement Period: Prompt correction required.

vii. When the BOPE cannot function to secure the hole, the hole shall be secured using cement, retrievable packer or a bridge plug packer, bridgeplug, or other acceptable approved method to assure safe well conditions.

Violation: Major.
Corrective Action: Install the equipment as specified.
Normal Abatement Period: Prompt correction required.

[54 FR 39528, Sept. 27, 1989]

b. Minimum standards and enforcement provisions for choke manifold equipment.

i. All choke lines shall be straight lines unless turns use tee blocks or are targeted with running tees, and shall be anchored to prevent whip and reduce vibration.

Violation: Minor.
Corrective Action: Install the equipment as specified.
Normal Abatement Period: 24 hours.

ii. Choke manifold equipment configuration shall be functionally equivalent to the appropriate example diagram shown in Attachment 1 of this Order. The configuration of the chokes may vary.

Violation: Minor.
Corrective Action: Install the equipment as specified.
Normal Abatement Period: Prompt correction required.

iii. All valves (except chokes) in the kill line choke manifold, and choke line shall be a type that does not restrict the flow (full opening) and that allows a straight through flow (same enforcement as item ii).

iv. Pressure gauges in the well control system shall be a type designed for drilling fluid service (same enforcement as above).

[57 FR 3025, Jan. 27, 1992]

c. Minimum standards and enforcement provisions for pressure accumulator system.

i. 2M system accumulator shall have sufficient capacity to close all BOP's and retain 200 psi above precharge. Nitrogen bottles that meet manufacturer's specifications.

Violation: Minor.
Corrective Action: Install the equipment as specified.
Normal Abatement Period: 24 hours.

ii. 3M system accumulator shall have sufficient capacity to open the hydraulically-controlled choke line valve(if so equipped), close all rams plus the annual preventer, and retain a minimum of 200 psi above precharge on the closing manifold without the use of the closing pumps. this is a minimum requirement. The fluid reservoir capacity shall be double the usable fluid volume of the accumulator system capacity and the fluid level shall be maintained at the manufacturer's recommendations. The 3M system shall have 2 independent power sources to close the preventers. Nitrogen bottles (3 minimum) may be 1 of the independent power sources and, if so, shall maintain a charge equal to the manufacturer's specifications.

Violation: Minor
Corrective Action: Install the equipment as specified.
Normal Abatement Period: 24 hours.

iii. 5M and higher system accumulator shall have sufficient capacity to open the hydraulically-controlled gate valve (if so equipped) and close all rams plus the annular preventer (for 3 ram systems add a 50 percent safety factor to compensate for any fluid loss in the control system or preventers) and retain a minimum pressure of 200 psi above precharge on the closing manifold without use of the closing unit pumps. The fluid reservoir capacity shall be double the usable fluid volume of the accumulator system capacity and the fluid level of the reservoir shall be maintained at the manufacturer's recommendations. Two independent sources of power shall be available for powering the closing unit pumps. Sufficient nitrogen bottles are suitable as a backup power source only, and shall be recharged when the pressure falls below manufacturer's specifications.

Violation: Minor.
Corrective Action: Install the equipment as specified.
Normal Abatement Period: 24 hours.

[57 FR 3025, Jan. 27, 1992]

d. Minimum standards and enforcement provisions for accumulator precharge pressuretest. This test shall be conducted prior to connecting the closing unit to the BOP stack and at least once every 6 months. The accumulator pressure shall be corrected if the measured precharge pressure is found to be above or below the maximum or minimum limit specified below (only nitrogen gas may be used to precharge):

| Accumulator working pressure rating | Minimum acceptable operating pressure | Desired precharge pressure | Maximum acceptable precharge pressure | Minimum acceptable precharge pressure |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1,500 psi | 1,500 psi | 750 psi | 800 psi | 700 psi |
| 2,000 psi | 2,000 psi | 1,000 psi | 1,100 psi | 900 psi |
| 3,000 psi | 3,000 psi | 1,000 psi | 1,100 psi | 900 psi |

Violation: Minor.
Correction Action: Perform test.
Normal Abatement Period: 24 hours.

e. Minimum standards and enforcement provisions for power availability. Power for the closing unit pumps shall be available to the unit at all times so that the pumps shall automatically start when the closing valve manifold pressure has decreased to the pre-set level.

Violation: Major.
Corrective Action: Install the equipment as specified.
Normal Abatement Period: Prompt correction required.

f. Minimum standards and enforcement provisions for accumulator pump capacity. Each BOP closing unit shall be equipped with sufficient number and sizes of pumps so that, with the accumulator system isolated from service, the pumps shall be capable of opening the hydraulically-operated gate valve (if so equipped), plus closing the annular preventer on the smallest size drill pipe to be used within 2 minutes, and obtain a minimum of 200 psi above specified accumulator precharge pressure.

g. Minimum standards and enforcement provisions for locking devices. A manual locking device (i.e., hand wheels) or automatic locking devices shall be installed on all systems of 2M or greater. A valve shall be installed in the closing line as close as possible to the annular preventer to act as a locking device. This valve shall be maintained in the open position and shall be closed only when the power source for the accumulator system is inoperative.

Violation: Minor.
Corrective Action: Install the equipment as specified.
Normal Abatement Period: 24 hours.

h. Minimum standards and enforcement provisions for remote controls. Remote controls shall be readily accessible to the driller. Remote controls for all 3M or greater systems shall be capable of closing all preventers. Remote controls for 5M or greater systems shall be capable of both opening and closing all preventers. Master controls shall be at the accumulator and shall be capable of opening and closing all preventers and the choke line valve (if so equipped). No remote control for a 2M system is required.

Violation: Minor.
Correction Action: Install the equipment as specified.
Normal Abatement Period: 24 hours.

i. Minimum standards and enforcement provisions for well control equipment testing.

i. Perform all tests described below using clear water or an appropriate clear liquid for subfreezing temperatures with a viscosity similar to water.

ii. Ram type preventers and associated equipment shall be tested to approved (see item I.D.1. of this order) stack working pressure if isolated by test plug or to 70 percent of internal yield pressure of casing if BOP stack is not isolated from casing. Pressure shall be maintained for at least 10 minutes or until requirements of test are met, whichever is longer. If a test plug is utilized, no bleed-off of pressure is acceptable. For a test not utilizing a test plug, if a decline in pressure of more than 10 percent in 30 minutes occurs, the test shall be considered to have failed. Valve on casing head below test plug shall be open during test of BOP stack.

iii. Annular type preventers shall be tested to 50 percent of rated working pressure. Pressure shall be maintained at least 10 minutes or until provisions of test are met, whichever is longer.

iv. As a minimum, the above test shall be performed:

A. when initially installed:
B. whenever any seal subject to test pressure is broken:
C. following related repairs: and
D. at 30-day intervals.

v. Valves shall be tested from working pressure side during BOPE tests with all down stream valves open.

vi. When testing the kill line valve(s), the check valve shall be held open or the ball removed.

vii. Annular preventers shall be functionally operated at least weekly.

viii. Pipe and blind rams shall be activated each trip, however, this function need not be performed more than once a day.

ix. A BOPE pit level drill shall be conducted weekly for each drilling crew.

x. Pressure tests shall apply to all related well control equipment.

xi. All of the above described tests and/or drills shall be recorded in the drilling log.

Violation: Minor.
Corrective action: Perform the necessary test or provide documentation.
Normal Abatement Period: 24 hours or next trip, as most appropriate.

[54 FR 39528, Sept. 27, 1989]

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**B. Casing and Cementing Requirements**

The proposed casing and cementing programs shall be conducted as approved to protect and/or isolate all usable water zones, lost circulation zones, abnormally pressured zones, and any prospectively valuable deposits of minerals. Any isolating medium other than cement shall receive approval prior to use. The casing setting depth shall be calculated to position the casing seat opposite a competent formation which will contain the maximum pressure to which it will be exposed during normal drilling operations. Determination of casing setting depth shall be based on all relevant factors, including: presence/absence of hydrocarbons; fracture gradients; usable water zones; formation pressures; lost circulation zones; other minerals; or other unusual characteristics. All indications of usable water shall be reported.

- Minimum design factors for tensions, collapse, and burst that are incorporated into the casing design by an operator/lessee shall be submitted to the authorized operator for his review and approval along with the APD for all exploratory wells or as otherwise specified by the authorized officer.

- Casing design shall assume formation pressure gradients of 0.44 to 0.50 psi per foot for exploratory wells (lacking better data).

- Casing design shall assume fracture gradients from 0.70 to 1.00 psi per foot for exploratory wells (lacking better data).

- Casing collars shall have a minimum clearance of 0.422 inches on all sides in the hole/casing annulus, with recognition that variances can be granted for justified exceptions.

- All waiting on cement times shall be adequate to achieve a minimum of 500 psi compressive strength at the casing shoe prior to drilling out.

1. Minimum Standards and Enforcement Provisions for Casing and Cementing.

a. All casing, except the conductor casing, shall be new or reconditioned and tested casing. All casing shall meet or exceed API standards for new casing. The use of reconditioned and tested used casing shall be subject to approval by the authorized officer: approval will be contingent upon the wall thickness of any such casing being verified to be at least 87 1/2 percent of the nominal wall thickness of new casing.

Violation: Major.
Corrective Action: Perform remedial action as specified by the authorized officer.
Normal Abatement Period: Prompt correction required.

[57 FR 3025, Jan. 27, 1992]

b. For liners, a minimum of 100 feet of overlap between a string of casing and the next larger casing is required. The interval of overlap shall be sealed and tested. The liner shall be tested by a fluid entry or pressure test to determine whether a seal between the liner top and next larger string has been achieved. The test pressure shall be the maximum anticipated pressure to which the seal will be exposed. No test shall be required for liners that do not incorporate or need a seal mechanism.

Violation: Minor.
Corrective Action: Perform remedial action as specified by the authorized officer.
Normal Abatement Period: Upon determination of corrective action.

c. The surface casing shall be cemented back to surface either during the primary cement job or by remedial cementing.
Corrective Action: Perform remedial cementing.
Normal Abatement Period: Prompt correction required.

d. All of the above described tests shall be recorded in the drilling log.

Violation: Minor.
Corrective Action: Perform the necessary test or provide documentation.
Normal Abatement Period: 24 hours.

e. All indications of usable water shall be reported to the authorized officer prior to running the next string of casing or before plugging orders are requested, whichever occurs first. Violation: Major.
Corrective Action: Report information as required.
Normal Abatement Period: Prompt correction required.

f. Surface casing shall have centralizers on the bottom 3 joints of the casing (a minimum of 1 centralizer per joint, starting with the shoe joint).

Violations: Major.
Corrective Action: Logging/testing may be required to determine the quality of the job. Recementing may then be specified.
Normal Abatement Period: Prompt correction upon determination of corrective action.

[57 FR 3025, Jan. 27, 1992]

g. Top plugs shall be used to reduce contamination of cement by displacement fluid. A bottom plug or other acceptable technique, such as a preflush fluid, inner string cement method, etc., shall be utilized to help isolate the cement from contamination by the mud fluid being displaced ahead of the cement slurry. Violation: Major.
Correction Action: Logging may be required to determine the quality of the cement job. Recementing or further recementing may then be specified.
Normal Abatement Period: Based upon determination of corrective action.

h. All casing strings below the conductor shall be pressure tested to 0.22

psi per foot of casing string length or 1500 psi, whichever is greater, but not to exceed 70 percent of the minimum internal yield. If pressure declines more than 10 percent in 30 minutes, corrective action shall be taken.

Violation: Minor.
Corrective Action: Perform the test and/or remedial action as specified by the authorized officer.
Normal Abatement Period: 24 hours.

i. On all exploratory wells, and on that portion of any well approved for a 5M BOPE system or greater, a pressure integrity test of each casing shoe shall be performed. Formation at the shoe shall be tested to a minimum of the mud weight equivalent anticipated to control the formation pressure to the next casing depth or at total depth of the well. This test shall be performed before drilling more than 20 feet of new hole.

Violation: Minor.
Corrective Action: Perform the specified test.
Normal Abatement Period: 24 hours.

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**C. Mud Program Requirements**

The characteristics, use, and testing of drilling mud and the implementation of related drilling procedures shall be designed to prevent the loss of well control. Sufficient quantities of mud materials shall be maintained or readily accessible for the purpose of assuring wellcontrol.

Minimum Standards and Enforcement Provisions for Mud Program and Equipment

1. Record slow pump speed on daily drilling report after mudding up.

Violation: Minor.
Corrective Action: Record required information.
Normal Abatement Period: 24 hours.

2. Visual mud monitoring equipment shall be in place to detect volume changes indicating loss or gain of circulating fluid volume.

Violation: Minor.
Corrective Action: Install necessary equipment.
Normal Abatement Period: 24 hours.

3. When abnormal pressures are anticipated, electronic/mechanical mud monitoring equipment shall be required, which shall include as a minimum; pit volume totalizer (PVT); stroke counter; and flow sensor.

Violation: Minor.
Corrective Action: Install necessary instrumentation.
Normal Abatement Period: 24 hours.

4. A mud test shall be performed every 24 hours after mudding up to determine, as applicable: density, viscosity, gel strength, filtration, and pH.

Violation: Minor.
Correction Action: Perform necessary tests.
Normal Abatement Period: 24 hours.

5. A trip tank shall be used on 10M and 15M systems and on upgraded 5M systems as determined by the authorized officer.

Violation: Minor.
Corrective Action: Install necessary equipment.
Normal Abatement Period: 24 hours.

6. a. Gas detecting equipment shall be installed in the mud return system for exploratory wells or wells where abnormal pressure is anticipated, and hydrocarbon gas shall be monitored for pore pressure changes.

b. Hydrogen sulfide safety and monitoring equipment requirements may be found in Onshore Oil and Gas Order No. 6 - Hydrogen Sulfide Operations.

Violation: Minor.
Corrective Action: Install necessary equipment.
Normal Abatement Period: 24 hours.

7. All flare systems shall be designed to gather and burn all gas. The flare line(s) discharge shall be located not less than 100 feet from the well head, having straight lines unless turns are targeted with running tees, and shall be positioned downwind of the prevailing wind direction and shall be anchored. The flare system shall have an effective method for ignition. Where noncombustible gas is likely or expected to be vented, the system shall be provided supplemental fuel for ignition and to maintain a continuous flare.

Violation: Major.
Corrective Action: Install equipment as specified.
Normal Abatement Period: 24 Hours.

8. A mud-gas separator (gas buster) shall be installed and operable for all systems of 10M or greater and for any system where abnormal pressure is anticipated beginning at a point at least 500 feet above any anticipated hydrocarbon zone of interest.

Violation: Minor.
Corrective Action: Install required equipment.
Normal Abatement Period: Prompt correction required.

[54 FR 39528, Sept. 27, 1989, further amended at 57 FR 3026, Jan.27, 1992]

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**D. Drill Stem Testing Requirements**

Initial opening of drill stem test tools shall be restricted to daylight hours unless specific approval to start during other hours is obtained from the authorized officer. However, DSTs may be allowed to continue at night if the test was initiated during daylight hours and the rate of flow is stabilized and if adequate lighting is available (i.e., lighting which is adequate for visibility and vapor-proof for safe operations). Packers can be released, but tripping shall not begin before daylight, unless prior approval is obtained from the authorized officer. Closed chamber DSTs may be accomplished day or night.

Minimum Standards for Drill Stem Testing.

1. A DST that flows to the surface with evidence of hydrocarbons shall be eitherreversed out of the testing string under controlled surface conditions or displaced into the formation prior to pulling the test tool. This would involve providing some means forreserve circulation.

Violation: Major.
Corrective Action: Contingent on circumstances and as specified by the authorizedofficer.
Normal Abatement Period: Prompt correction required.

2. Separation equipment required for the anticipated recovery shall be properly installed before a test starts.

Violation: Major.
Corrective Action: Install required equipment.
Normal Abatement Period: Prompt correction required.

3. All engines within 100 feet of the wellbore that are required to "run" during the test shall have spark arresters or water cooled exhausts.

Violation: Major.
Corrective Action: Contingent on circumstances and as specified by the authorized officer.
Normal Abatement Period: Prompt correction required.

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**E. Special Drilling Operations**

1. In addition to the equipment already specified elsewhere in this onshore order, the following equipment shall be in place and operational during air/gas drilling:

- Properly lubricated and maintained rotating head*
- Spark arresters on engines or water cooled exhaust*
- Blooie line discharge 100 feet from well bore and securely anchored
- Straight run on blooie line unless otherwise approved
- Deduster equipment*
- All cuttings and circulating medium shall be directed into a reserve or blooie pit*
- Float valve above bit*
- Automatic igniter or continuous pilot light on the blooie line*
- Compressors located in the opposite direction from the blooie line a minimum of 100 feet from the well bore
- Mud circulating equipment, water, and mud materials (does not have to be premixed) sufficient to maintain the capacity of the hole and circulating tanks or pits

Violation: Minor (unless marked by an asterisk).
Corrective Action: Install the equipment as specified.
Normal Abatement Period: 24 hours.

*Violation: Major.
Corrective Action: Install the equipment as specified.
Normal Abatement Period: Prompt correction required.

2. Hydrogen sulphide operation is specifically addressed under Onshore Oil and Gas Order No. 6.

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**F. Surface Use**

Onshore Oil and Gas Order No. 1 specifically addresses surface use. That Order provides for safe operations, adequate protection of surface resources and uses, and other environmental components. The operator/lessee is responsible for, and liable for, all building, construction, and operating activities and subcontracting activies conducted in association with the APD. Requirements and special stipulations for surface use are contained in or attached to the approved APD.

Minimum Standards and Enforcement Provisions for Surface Use.

The requirements and stipulations of approval shall be strictly adhered to by the operator/lessee and any contractors. Violation: If a violation is identified by the authorized officer he shall dtermine wherther it is major or minor, considering the definitions in 43 CFR 3160.0-5, and shall specify the appropriate corrective action and abatement period.

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**G. Drilling Abandonment Requirements**

The following standards apply to the abandonment of newly drilled dry or non-productive wells in accordance with 43 CFR 3162.3-4 and section V of Onshore Oil and Gas Order No. 1. Approval shall be obtained prior to the commencement of abandonment. All formations bearing usable-quality water, oil, gas, or geothermal resources, and/or a prospectively valuable deposit of minerals shall be protected. Approval may be given orally by the authorized officer before abandonment operations

are initiated. This oral request and approval shall be followed by a written notice of intent to abandon filed not later than the fifth business day following oral approval. Failure to obtain approval prior to commencement of abandonment operations shall result in immediate assessment of under 43 CFR 3163.1(b)(3). The hole shall be in static condition at the time any plugs are placed (this does not pertain to plugging lost circulation zones). Within 30 days of completion of abandonment, a subsequent report of a abandonment shall be filed. Plugging design for an abandonment hole shall include the following:

1. Open Hole.

i. A cement plug shall be placed to extend at least 50 feet below the bottom (except as limited by total depth (TD) or plugged back total depth (PBTD)), to 50 feet above the top of:

a. Any zone encountered during which contains fluid or gas with a potential to migrate;
b. Any prospectively valuable deposit of minerals.

ii. All cement plugs, except the surface plug, shall have sufficient slurry volume to fill 100 feet of the hole, plus an additional 10 percent of slurry for each 1,000 feet of depth.

iii. No plug, except the surface plug, shall be less than 25 sacks without receiving specific approval from the authorized officer.

iv. Extremely thick sections of single formation may be secured by placing 100-foot plugs across the top and bottom of the formation, and in accordance with item ii hereof. v. In the absence of productive zones or prospectively valuable deposits of minerals which otherwise require placemnt of cement plugs, long sections of open hole shall be plugged at least every 3,000 feet. Such plugs shall be placed across in-gauge sections of the hole, unless otherwise approved by the authoriuzed officer.

2. Cased Hole. A cement plug shall be placed opposite all open perforation and extend to a minimum of 50 feet below (except as limited by TD or PBTD) to 50 feet above the perforated interval. All cement plugs, except the surface plug, shall have sufficient slurry volume to fill 100 feet of hole, plus an additional 10 percent of slurry for each 1,000 feet of depth. In lieu of the cement plug, a bridge plug is acceptable, provided:

i. The bridge plug is set within 50 feet to 100 feet above the open perforations;
ii. The perforations are isolated from any open hole below; and
iii. The bridge plug is capped with 50 feet of cement. If a bailer is used to cap this plug, 35 feet of cement shall be sufficient.

3. Casing Removed from Hole. If any casing is cut and recovered, a cement plug shall be placed to extend at least 50 feet above and below the stub. The exposed hole resulting from the casing removal shall be secured as required in items 1i and 1ii hereof.

4. An additional cement plug placed to extend a minimum of 50 feet above and below the shoe of the surface casing for intermediate string, as appropriate).

5. Annular Space. No annular space that extends to the surface shall be left open to the drilled hole below. If this condition exists, a minimum of the top 50 feet of annulus shall be plugged with cement.

6. Isolating Medium. Any cement plug which is the only isolating medium for a usable water interval or a zone containg a prspectively valuable deposit of minerals shall be testedby tagging with the drill string. Any plugs placed where the fluid level will not remain static also shall be tested by either tagging the plug with the working pipe string, or pressuring to a minimum pump (surface) pressure of 1,000 psi, with no more than a 10 percent drop during a 15-minute period (cased hole only). If the integrity of any other plug is questionable, or if the authorized officer has specific concerns for which he/she orders a plug to be tested, it shall be tested in the same manner.

7. Silica Sand or Silica Flour. Silica sand or silica flour shall be added to cement exposed to bottom hole static temperatures above 230 øF to prevent heat degradation of the

cement.

8. Surface Plug. A cement plug of at least 50 feet shall be placed across all annuluses. The top of this plug shall be placed as near the eventual casing cutoff point as possible.

9. Mud. Each of the intervals between plugs shall be filled with mud of suffcient density to exert hydrostatic pressure exceeding the greatest formation pressure encountered while drilling such interval. In the absense of other information at the time plugging is approved, a minimum mud weight of 9 pounds per gallon shall be specified.

10. Surface Cap. All casing shall be cut-off at the base of the cellar or 3 feet below final restored ground level (whichever is deeper). The well bore shall then be covered with a metal plate at least 1/4 inch thick and welded in place, or a 4-inch pipe, 10-feet in length, 4 feet above ground and embedded in cement as specified by the authorizedofficer. The well location and identity shall be permanently inscribed. A weep hole shall be left if a metal plate is welded in place.

11. The cellar shall be filled with suitable material as specified by the authorized officer and the surface restored in accordancxe with the instructions of the authorized officer.

Minimum Standard

> All plugging orders shall be strictly adhered to.
>
> Violation: Major.
> Corrective Action: Contingent upon circumstances.
> Normal Abatement Period: Prompt correction required.
>
> [54 FR 39528, Sept. 27, 1989]

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## IV. Variances From Minimum Standard

An operator may request the authorized officer to approve a variance from any ofthe minimum standards prescribed in section III hereof. All such request shall be submitted in writing to the appropriate authorized officer and provide information as to the circumstances which warrant approval of the variance(s) requested and the proposed alternative methods by which the related minimum standard(s) are to be satisfied. The authorized officer, afterconsidering all relevant factors, if appropriate, may approve the requested variance(s) if it is determined that the proposed alternative(s) meet or exceed the objectives of the applicable minimum standard(s).

Emergency or other situations of an immediate nature that could not be reasonably forseen at the time of APD approval may recieve oral approval. However, such requests shall be followed up by a written notice filed not later than the fifth business day following oral approval.

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## ATTACHMENTS

I. Diagrams of Choke Manifold Equipment
II. Sections From 43 CFR Subparts 3163 and 3165 (Not included With Federal Register Publication)

# APPENDIX L: GUIDELINE FOR THE DETECTION AND QUANTIFICATION OF CONTAMINATION AT OIL AND GAS OPERATIONS

**Prepared by**
**Mark VanMouwerik**
**CSU Research Associate/Contaminants Specialist**
**November 1999**

**Updated by**
**Pete Penoyer**
**Hydrologist**
**Water Resources Division**
**National Park Service**
**Fort Collins, Colorado**
**May 2004**

## I. WHAT IS THE PURPOSE OF THIS DOCUMENT?

This document is to be used as a guideline for collecting samples at sites within National Park Service (NPS) units where there are oil or gas operations. Samples will indicate whether or not contamination exists at the site as a result of an operation.

It is important that specific contaminants are tested for and that specific methodology is used so that contamination is accurately defined and so that results taken at different times by different people at the same site can be reliably compared. This guideline presents methodology for analyzing soil, sediment, groundwater, and surface water.

Specifically, guidelines are presented for: 1) when owner/operators must collect samples, 2) what contaminants to test for, 3) how to collect samples, 4) quality assurance/quality control, 5) how to analyze samples in the laboratory, 6) required detection limits and choosing environmental benchmarks, and 7) sample plan and reporting requirements.

Note that in this guideline “Superintendent” refers to the Superintendent and/or members of his/her staff who will represent him/her on these issues. In many cases, the Superintendent's actual involvement may be only that of approving the recommendations of the staff member(s).

## II. WHEN AND WHERE TO COLLECT SAMPLES

The Superintendent can require sampling by an operator at a site if it has recently experienced a release, has a history of releases, or the facility is operated in a manner that poses a risk of releasing crude oil, natural gas condensates, produced water, or any other “contaminating substance” associated with an oil or gas operation.

Sampling can occur at any time during or after an operation. (“After” refers to when an owner/operator sells the operation, transfers its leasing rights, or closes the operation and abandons the site.) In most instances, sampling by the operator should be conducted under the direction of a Sampling and Analysis Plan that has been approved by the Superintendent to

ensure all work will be performed in a professional manner, meets the resource protection needs of the park, and with the knowledge of the appropriate Park staff.

Sampling will be biased, not random, focusing on areas where contamination is obvious (visible) or suspected (such as near production or storage facilities). The exact sample locations and number of samples collected are site-specific and will be determined by the Superintendent, or proposed by the site operator in a Sampling and Analysis Plan or Work Plan submitted to the Superintendent for review and approval. Owner/operators are responsible for sample collection, sample analyses, and reporting of results, not NPS.

Sample data from a nearby (but off-site) "clean" location will be needed to determine "background" concentrations at the site for the contaminants of concern. A comparison of the contaminated site data with "background" data will allow resource managers to determine how contaminated the site is. If the site has been remediated, comparisons of sample data with "background" data can indicate if the clean-up met the Superintendent's remediation goals for the site.

Note that incoming owner/operators at new or existing oil or gas operations may wish to test the site for contamination before they begin operations. If they choose to do so, it is strongly suggested they test for the contaminants and use the methodology given in this guideline so that if samples are required during or after the operation for any reason, all data can be reliably compared.

## III. WHAT CONTAMINANTS TO TEST FOR

Contaminating substances that can be found at oil and gas sites are primarily crude oil, natural gas condensate, produced water, drilling mud, lube (motor) oil, and solvents. The individual contaminants found in these substances are listed in Table 1. Though other contaminants also are found in these substances, those in Table 1 were chosen because of their greater environmental toxicity and because they are good indicators of the presence of the contaminating substance(s) of interest.

When contamination of a site by one of these six contaminating substances is being investigated, sampling and analyses for some or all of the individual contaminants found in that contaminating substance should occur. Two lists of contaminants were compiled and are designated as "Tier I" (the smaller group, indicated by "xx" in Table 1) and "Tier II" (the more comprehensive group, indicated by both "xx" and "x"). Having two tiers to choose from allows the Superintendent flexibility in what contaminants he/she requires that the operator test for. The Tier I contaminants are included in the Tier II contaminants and therefore will always be tested for.

Tier I sampling should be conducted when basic information is needed. For instance, if contamination at a site is suspected but not known, testing for Tier I contaminants will confirm this; it will also give an idea of the severity of contamination. Tier I sampling might also be conducted where Park natural resources (like groundwater, vegetation, or surface water) are at low/no risk.

**TABLE 1: CONTAMINANTS TO TEST FOR WHEN INVESTIGATING VARIOUS TYPES OF CONTAMINATION AT OIL AND GAS SITES.**

Contaminants that should be tested for during Tier I sampling are indicated by "xx", while those with either an "x" or "xx" should be tested for during Tier II sampling.

| containmant | where found: soil/sediment = S groundwater/surface water = W | Contaminating substances individual contaminants are associated with: crude oil | condensate [j] | produced water | drilling mud | lube (motor) oil | solvents [k] |
|---|---|---|---|---|---|---|---|
| PAHs [a] | S, W | x | x | x | x | x | x |
| TPH [b] | S, W | xx | xx | x | x | xx | xx |
| BTEX [c] | S, W | x | xx | x | x | x | xx |
| | | | metals | | | | |
| arsenic | S, W | x | | x | x | | |
| barium | S, W | x | | xx | xx | x | |
| cadmium | S, W | x | | x | x | x | |
| chromium | S, W | x | | x | xx | | |
| copper | S, W | x | | x | x | x | |
| iron | S, W | | x | | | x | |
| lead | S, W | x | | x | x | xx | |
| magnesium | S, W | x | | x | x | x | |
| mercury [e] | S, W | x | | x | x | | |
| nickel | S, W | xx | | x | | x | |
| selenium | S, W | x | | | x | | |
| strontium | S, W | x | | xx | | | |
| vanadium | S, W | xx | | x | x | | |
| zinc | S, W | x | | xx | x | xx | |
| ammonia | W | x | | x | | | |
| calcium | W | | | x | x | x | |
| chloride | S, W | | | xx | | | |
| potassium | W | x | | x | x | | |
| sodium | S, W | | | | xx | xx | xx |
| sulfates | W | | | x | | | |
| gross alpha emissions [g] | W | | | x | | | |
| radium-226 [g] | S | | | xx | | | |
| pentachlorophenol | S, W | | | | x | | |
| surfactants | S, W | | | | x | | |
| pH | S, W | x | x | x | x | | |
| conductivity/salinity [h] | S, W | | x | xx | xx | | |
| TDS | W | | | x | x | | |
| grain size | S | x | x | x | xx | x | |
| total organic carbon | S | x | x | x | x | x | x |
| percent moisture [i] | S | xx | xx | xx | xx | xx | xx |
| static water level [j] | W | xx | xx | xx | xx | xx | xx |
| temperature | W | xx | xx | xx | xx | xx | xx |

a = Polycyclic Aromatic Hydrocarbons. The lab analysis required in this guideline detects approximately 38 individual compounds including the priority pollutant “parent” compounds and their alkylated homologs. See Table 2 for a full list of these. Note that these 38 compounds are measured with a single analytical test (i.e. there is not a separate test for each compound). When testing water for PAHs, do for groundwater only unless ongoing surface water contamination from adjacent contaminated soil, sediment, or aquifer is suspected.

b = Total Petroleum Hydrocarbons. Certain "ranges" of hydrocarbons should be analyzed for, depending on the contaminating substance. For crude oil, a “full range” or “wide range” TPH scan should be conducted; for natural gas condensate a “lighter end” TPH scan, like for “gasoline range organics” (GRO) or total volatile petroleum hydrocarbons (TVPH) $C_6$-$C_{10}$ should be conducted; and for diesel fuel a TPH scan for “diesel range organics” (DRO) or total extractable petroleum hydrocarbons (TEPH) $C_{11}$-$C_{34}$ should be conducted. See section VI.A for details.

c = Benzene, Toluene, Ethylbenzene, Xylene. Only test for these in soil, sediment, or surface water if contamination is very recent and sampling is for initial (preliminary) assessment purposes.

d = analyze all metals for the “total recoverable” fraction

e = analyze soil (or sediment) for mercury only if mercury manometers are suspected to have been used on-site in the past (natural gas operations only)

f = report both the “total” and “unionized” fractions

g = note that if gross alpha in water exceeds a certain level, further testing for radioactive elements may be required. Radium-226 analyses must use gamma spectroscopy; this test takes approx. 30 days. At sites where produced water contamination may be more recent (in the last 10 yrs), gamma ray emissions in the soil can be preliminarily measured in the field (e.g. with a MicroRmeter) to determine if the radium-226 soil analyses are necessary.

h = salinity can be calculated from conductivity measurements

i = percent moisture is necessary to calculate the required dry weight and wet weight units

j = for groundwater only

k = can be from a gas production facility or a gas pipeline

l = various solvents can be used on-site (e.g. benzene, toluene, ethylbenzene, xylene, various petroleum products, etc.). Analyte tested for depends on the particular solvent used on-site.

**Table 2:** Polycyclic aromatic hydrocarbons (PAHs) detected by the recommended “expanded scan” analysis for PAHs (see section VI.A). These compounds include the so-called priority pollutant “parent” compounds plus their alkylated homologs. Note that the 38 compounds below are measured with a single analytical test (that is, there is not a separate analytical test for each compound).

Acenaphthene
Acenaphthylene

Anthracene
Benzo(a)anthracene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(g,h,i)perylene
Benzo(e)pyrene
Benzo(a)pyrene
Biphenyl
Chrysene
Chrysene, C1-
Chrysene, C2-
Chrysene, C3-
Chrysene, C4-
Dibenzo(a,h)anthracene
Dibenzothiophene
Dibenzothiophene, C1-
Dibenzothiophene, C2-
Dibenzothiophene, C3-
Fluoranthene
Fluoranthenes/Pyrenes, C1-
Fluorene
Fluorene, C1-
Fluorene, C2-
Fluorene, C3-
Ideno(1,2,3,c,d)pyrene
Naphthalene
Naphthalene, C1-
Naphthalene, C2-
Naphthalene, C3-
Naphthalene, C4-
Perylene
Phenanthrene
Phenanthrenes/Anthracenes, C1-
Phenanthrenes/Anthracenes, C2-
Phenanthrenes/Anthracenes, C3-
Phenanthrenes/Anthracenes, C4-

Tier II sampling should be conducted when more detailed information is needed. For instance, if clean-up activities at a site have been completed, testing for Tier II contaminants will confirm if all (or nearly all) the contaminants have, in fact, been removed. Tier II sampling might also be conducted at sites where important Park natural resources are at a higher risk of being exposed to contaminants and where more stringent cleanup standards than those promulgated by a State regulatory body may be appropriate.

The Superintendent will determine whether Tier I or II is needed. Some combination of the two may also be used. He/she may also choose to omit or add contaminants to the Tier I or II lists should the situation warrant it.

Note that Table 1 does not include all possible contaminants associated with oil or gas operations. Other contaminating substances involved are: caustic solutions used in natural gas sweetening (these can contain sodium, pH, amines, and EDTA contaminants); glycols used in

natural gas dehydration; and surfactants, acidizing agents, corrosion inhibitors, solvents, biocides, etc. used in oil or gas well workover and completion. The Superintendent may require that contaminants associated with these substances be tested for if they are suspected of having been released on-site.

# IV. HOW TO COLLECT SAMPLES

## A. Sample Locations

### 1. Soil

Background samples should be collected from an area as close to the site as possible where it is certain no contaminating substances from the site could have reached (from surface runoff, off-site dumping, migration from wind, etc.).

For soils that are known to be contaminated, samples should be collected from the spot and depth where contamination appears to be highest. For sites where soils are suspected of being contaminated, seek out areas near production facilities, storage tanks, valves, etc., and adjacent low points in the topography where contaminated runoff may have passed over or "puddled up" and concentrated. Collect sample at a depth where contamination would be highest: in most cases probably the top one to two inches. Note that releases in very porous (e.g. sandy) soil may percolate down and pool immediately above deeper, less porous soil layers (e.g. clay or silt strata, particularly if saturated), pool at the water table, or concentrate in highly organic layers.

For sites where removal of contaminated soils has already occurred, a sample should be collected in the top inch or so of the newly exposed soil to insure that all the contaminants that percolated down into the soil were, in fact, removed. (Note: At hydrocarbon release sites, screening of soils at the base of the excavation for volatile organic compounds/VOCs with a photo-ionization detector could improve the confidence that Tier II sample selection is sufficient to confirm a site is clean.)

All samples will be grab samples. (As a rule, composite samples should not be collected.) Where contamination is suspected but not known, the sampling device probably should be some type of tube or auger in order to capture equal amounts of soil over the depth of the profile; depending on the properties of the soil (like how hard or rocky it is), however, other devices (like a trowel) may work better. Sample collectors may have to communicate with the laboratory to ensure that enough soil is collected for the various analyses.

For BTEX samples, see section B.1. below.

The total number of samples to be collected will be site-specific and determined by the Superintendent. Enough samples should be collected and analyzed to meet the Tier I or Tier II sampling objective (see section III).

### 2. Sediment

Background samples should be collected from sediment adjacent to the sediments in question, but where it is reasonably certain no contaminating substances from the site (or other sites in the area) could have reached (from surface runoff, off-site dumping, etc.).

As with soils, sediments known to be contaminated should be sampled from the spot and depth where contamination appears to be highest. For sediments suspected of being contaminated, seek out areas near production facilities, storage tanks, valves, etc., and adjacent areas where potentially contaminated sediment in runoff could have settled out. Sample the sediment that has accumulated since the spill/release began. In some cases this may be the top ¼ inch, in others it may be the top several inches.

For sites where removal of contaminated sediments has already occurred, samples should be collected in the newly exposed sediment to insure that all contaminants were, in fact, removed.

All samples will be grab samples. (As a rule, composite samples should not be collected.) Where contamination is suspected but not known, or the layer of contaminated sediment is more than a couple inches thick, the sampling device probably should be some type of tube or auger in order to capture equal amounts of sediment over the depth of the profile; depending on the properties of the sediment (like how rocky it is) and the depth of the water, however, other devices may work better. Sample collectors may have to communicate with the laboratory to ensure that enough sediment is collected for the various analyses.

The total number of samples to be collected will be site-specific and determined by the Superintendent. Enough samples should be collected and analyzed to meet the Tier I or Tier II sampling objective (see section III).

### 3. Groundwater

Groundwater samples should be collected if the Superintendent determines that hydrogeological conditions at the site are such that groundwater resources under or near the site are reasonably at risk. Samples can be collected either via established monitoring wells or with “push” technology (such as Geoprobe®).

It is critical that: a) sampling occurs in the right areas (for example, one location must be upgradient of the potential point of impact and at least two must be downgradient); and b) wells are screened at the appropriate depths to intercept any contaminant plume(s). (This will require knowledge of the local hydrogeology and the contaminants involved and their environmental fate characteristics). If “push” technology is used to collect soil samples for lab analysis or for on-site screening of various media (soil, ground water) for contaminants and samples are collected on more than one occasion, care must be taken to sample the exact same locations and at the same depths in the aquifer. Typically, once contamination is found in ground water using screening methodologies, monitoring wells are required by State regulatory agencies to ensure sample quality and integrity is sufficient to base regulatory decisions.

“Low-flow” sample collection methods should be used as per the EPA guidance document in IV.B.3 below.

Groundwater samples should not be filtered.

For BTEX samples, see section B.3. below.

All samples will be grab samples. (As a rule, composite samples should not be collected.) Sample collectors may have to communicate with the laboratory to ensure that enough sample is collected for the various analyses.

The total number of samples to be collected will be site-specific and determined by the Superintendent or through his/her approval of the owner/operator's Sampling and Analysis Plan after consultation with Park resource staff. Enough samples should be collected and analyzed to meet the Tier I or Tier II sampling objective (see section III).

### 4. Surface Water

Background samples should be collected upstream of any possible inputs of contaminated water (e.g. surface runoff or shallow groundwater) from the site.

Where contamination is obvious, such as in a surface sheen, collect samples right at the surface, avoiding any scum, algae, or other detritus on the water surface if possible (and note in fieldbook if present). Where a contaminating substance such as chlorinated solvents (dense nonaqueous phase liquids, or DNAPLs) was released or is suspected at the bottom of an aquifer (e.g. above a clay layer or aquitard), then collect samples at a depth immediately above the base of the aquifer, the depth of the first fine-grained layer below the water table, or both. For surface water suspected of being contaminated but it is unknown whether the contaminants are "floaters" or "sinkers," collect samples at a depth of 3-12 inches.

For BTEX samples, see section B.4. below.

Again, all samples will be grab samples. (As a rule, composite samples should not be collected.) Sample collectors may have to communicate with the laboratory to ensure that enough sample is collected for the various analyses.

The total number of samples to be collected will be site-specific and determined by the Superintendent. Factors such as flow, depth, and the size of the water body are important here. Enough samples should be collected and analyzed to meet the Tier I or Tier II sampling objective (see section III).

## B. Sample Collection Methodologies

Acceptable sampling methodology must be used so that results are as representative as possible. Sample collection can be complex and should be conducted by experienced professionals (typically a contractor). This could also help if the values or methods are challenged by one of the interested parties involved (State regulatory agency, Park, owner/operator etc.). Furthermore, experienced professionals are also trained in the appropriate precautions to protect the health and safety of the sample collector(s) from exposure to potentially harmful contaminants or hazardous situations that could develop.

Methodologies that should be used are typically those accepted/sanctioned by the appropriate State regulatory agency or are found in publications of widely recognized organizations (e.g. EPA, NOAA) that conduct environmental research. Acceptable methodologies are listed below for each environmental media (soil, sediment, etc.). In general, the State is authorized as the lead regulatory agency and should be the initial contact for appropriate sampling methodologies to employ when various environmental media are believed contaminated. In site-specific situations where a sensitive Park resource is threatened and more stringent cleanup than that required by a State agency may be appropriate, Park staff should consult WASO support offices as needed for appropriate criteria prior to discussion of more stringent cleanup levels with the owner/operator. If sample collection methodologies other than the above are used, they must contain the following to be acceptable: 1) Applicability of the procedure, 2) Equipment required,

3) Detailed description of procedures to be followed in collecting the samples, 4) Common problems encountered and corrective actions to be followed, and 5) Precautions to be taken. The methodology to be used must be cited in the sample plan. A basic description of collection methodology should be included in the report to the Superintendent (section VIII).

## 1. Soil

Methods from source documents published by the following organizations are acceptable:

-State Governing Regulatory Agency
-U.S. EPA
-American Society for Testing and Materials
-U.S. Department of the Interior
-American Petroleum Institute

Note that when collecting soil samples for BTEX analysis, specialized equipment and collection methods are necessary. Use a coring device such as the EnCore™ sampler or disposable plastic syringes. For detailed guidance, see section 4.1 and method 5035 in Chapter 4 of EPA's SW-846, Update III (full reference in section VI.A. below).

## 2. Sediment

Methods from source documents published by the following organizations are acceptable:

-State Governing Regulatory Agency
-U.S. EPA
-American Society for Testing and Materials
-U.S. Department of the Interior
-American Petroleum Institute

## 3. Groundwater

Use: Environmental Protection Agency. 1992. RCRA Ground-Water Monitoring: Draft Technical Guidance. EPA/530/R-93-001. Office of Solid Waste, EPA, Washington, D.C.; or Publications of State Governing Regulatory Agency (DEQ, DEM, State EPA etc.)

"Low-flow" sampling should be conducted; for guidance, see:

Puls, R.W. and M.J. Barcelona. 1996. Ground Water Issue: Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures. EPA/540/S-95/504. Office of Solid Waste and Emergency Response, EPA, Washington, D.C.

Note that when collecting water samples for BTEX analysis, specialized equipment and collection methods are necessary. For detailed guidance, see section 4.1 and method 5030B in Chapter 4 of EPA's SW-846, Update III (full reference in section VI.A. below).

### 4. Surface Water

Methods from source documents published by the following organizations are acceptable:

-State Governing Regulatory Agency
-U.S. EPA
-American Society for Testing and Materials
-U.S. Department of the Interior
-American Petroleum Institute

Also recommended is this NPS guidance: Stednick, J.D. and D.M. Gilbert. 1998. Water quality inventory protocol: Riverine environments. National Park Service, Water Resources Division, Technical Report no. NPS/NRWRD/NRTR-98/177. Fort Collins, CO, 103 pp.

Note that when collecting water samples for BTEX analysis, specialized equipment and collection methods are necessary. For detailed guidance, see section 4.1 and method 5030B in Chapter 4 of EPA's SW-846, Update III (full reference in section VI.A. below).

## C. Sample Containers, Preservation, Storage

Refer to documents listed in sections VI.A. below and IV.B. above for specific guidance, including 40 CFR Part 136, if necessary. EPA's SW-846, Update III is especially helpful.

Note that sediment samples should not be acidified for metals and that neither groundwater nor surface water samples should be filtered. Remember special conditions when sampling for BTEX (see section 4.1 and methods 5030 and 5035 in Chapter Four of SW-846, Update III) and for any metals requiring unusually low detection limits.

## D. Chain of Custody

Proper chain-of-custody procedures must be used in sample handling (collection, shipping, storage, analysis). For examples, see Standard Methods for the Examination of Water and Wastewater for general guidance, and SW-846, Update III, Chapter 9, section 9.2.2.7 for detailed guidance.

# V. QUALITY ASSURANCE/QUALITY CONTROL

Quality assurance/quality control (QA/QC) plans or Quality Assurance Project Plans (QAPPs) ensure that the data generated are scientifically valid, defensible, and of known precision and accuracy. Some of the basic elements of QA/QC or QAPP plans are:

- data quality objectives (DQO)
- field operating procedures (such as sample management, decontamination, equipment calibration, etc.)
- field QA/QC requirements (such as data handling, collection of control samples like blanks, spikes and duplicates, etc.)
- lab operating procedures (such as sample management, equipment calibration, etc.)
- lab QA/QC procedures (such as data handling, control samples, etc.).

A QA/QC plan should be in place before any sampling begins. Basic QA/QC procedures to be followed should be described briefly in the sample plan (section VIII). If a certain QA/QC guidance document is used, it should be cited in the sample plan. Many guidance documents are available—several through EPA—including the following, recommended here:

> Environmental Protection Agency. 1997. Test methods for evaluating solid waste, physical/chemical methods (SW-846), 3rd edition, Update III, Chapter One. EPA Office of Solid Waste and Emergency Response, EPA, Washington, D.C.

Adherence to the QA/QC plan should be documented throughout the project and demonstrated in the final report to the Superintendent.

Aspects of quality assurance that may be helpful can be found in:

> Environmental Protection Agency. 1996. The volunteer monitor's guide to quality assurance project plans. EPA Office of Wetlands, Ocean and Watersheds 4503F. EPA publication number: EPA 841-B-96-003. Also available at: http://www.epa.gov/owow/monitoring/volunteer/qappcover.htm

# VI. HOW TO ANALYZE SAMPLES IN THE LABORATORY

## A. Analytical Methods

Metals analyses must use the methods in EPA's SW-846, Update III (or more recent). This applies to soil, sediment, groundwater, and surface water samples. Groundwater and surface water methods can also include EPA's 200 series for metals, or the 1600 series where extremely low (state-of-the-art) detection limits are desired. The full reference for the SW-846 document is:

> Environmental Protection Agency. 1997. Test methods for evaluating solid waste, physical/chemical methods (SW-846), 3rd edition, Update III. EPA Office of Solid Waste and Emergency Response, EPA, Washington, D.C.

Polycyclic aromatic hydrocarbon (PAH) analyses must use a modification of method 8270 in EPA's SW-846, Update III. Developed by the National Oceanic and Atmospheric Administration (NOAA), this method is referred to as "GC/MS method 8270 in selective ion mode (SIM)", and is informally referred to as the "expanded scan" for PAHs. Consult the following for a detailed explanation of methodology:

> Lauenstein, G.G., and A.Y. Cantillo (1998). Sampling and analytical methods of the National Status and Trends Program Mussel Watch Project: 1993-1996 update. NOAA Technical Memorandum NOS ORCA 130. 233 pp.

Total petroleum hydrocarbons (TPH) analyses will be for certain "ranges" of hydrocarbons, depending on the contaminating substance present. For crude oil, a **"wide range" or "full range" TPH scan** should be conducted to measure the heavier fractions. For natural gas condensate a "lighter end" TPH scan, such as for **"gasoline range organics" (GRO)**, should be conducted. For diesel fuel, a TPH scan for **"diesel range organics" (DRO)** should be conducted to measure the mid-range fractions. Although many analytical methods are available for TPH, samples should be analyzed using only GC/FID (gas chromatograph/flame ionization detection) methodology. Method 8015B in EPA's SW-846, Update III is highly recommended.

Benzene, toluene, ethylbenzene, and xylene (BTEX) analyses should use method 8260B in EPA's SW-846, Update III. Analysis for BTEX compounds is typically done in place of a TPH analysis when a refined product is released as opposed to crude oil.

Ammonia analyses should use EPA method 350.1 (or equivalent APHA method 4500-NH3 H, or USGS method 4523-85). Samples should not be filtered.

For all other contaminants in Table 1, use methods approved in 40 CFR Part 136 (EPA, Standard Methods for the Examination of Water and Wastewater (latest edition), ASTM, or USGS). Methods in the NPS, Water Resources Division "Water quality inventory protocol" (section IV.B.4 above) can also be used.

## B. Laboratories

Samples must be sent to an experienced lab that can: 1) perform the above analytical methods; 2) achieve the required detection limits (section VII below); 3) perform the required QA/QC procedures (section V above); and 4) provide the information required in the sample plan and the final report to the Superintendent (section VIII below).

Note that in regards to the PAH analytical method (as specified in VI.A. above), only a few labs nationwide (perhaps a dozen) currently can perform this analysis. Many of these same labs can also "fingerprint" samples; that is, by analyzing hydrocarbon-contaminated samples, they can identify the type and source of the petroleum product at the site. A partial list of these labs follows (no government endorsement implied):

Arthur D. Little, Inc.
25 Acorn Park
Cambridge, MA. 02140
(617) 498-5000

Battell Marine Science Lab
1529 West Sequim Bay Rd.
Sequim, WA 98382
(360) 683-4151

Geochemical and Environmental Research Group
Texas A&M University
833 Graham Rd.
College Station, TX. 77845
(409) 862-2323 ext. 115

Woods Hole Group, Environmental Laboratories
375 Paramount Drive, Suite B
Raynham, MA 02767-5154
(508) 822-9300 or 563-5030

# VII. DETECTION LIMITS

Note: The term "detection limit" used herein refers to what is commonly called the "reporting limit" and occasionally called the "quantitation limit. A detection limit is what a lab (using a particular instrument in some combination with analytical method and skill level of operator) can quantify low levels of a contaminant substance with acceptable confidence. It does not refer to the sometimes much lower "instrument detection limit" or "method detection limit" where how well the value obtained represents the true value may be of low confidence. Also note that detection limits should not be confused with cleanup standards or cleanup criteria. Required cleanup levels/criteria are usually set by State regulatory authorities as the acceptable contaminant residue (usually well above detection limits) that may remain in some environmental media after a remedial effort has occurred. NPS is authorized to require more stringent cleanup criteria on a case-by-case basis, particularly in site-specific situations where sensitive ecological resources

could be threatened. Widely accepted, peer-reviewed research may then be used to support the NPS position that State criteria are not sufficiently protective and lower cleanup criteria are warranted.

Labs should achieve the detection limits (DLs) provided in Table 3 below. These DLs are below federal (and presumably state) standards and most other criteria currently in the literature. Therefore, analytical methods that achieve these DLs will be able to indicate if most standards and criteria are being met. Note, however, that the DLs for two contaminants—PAHs and mercury—are above some of the more strict standards or criteria that exist. This is because many labs cannot achieve DLs this low, and the DLs in the table were chosen so that most experienced and well-equipped labs could achieve them. Lower DLs are achievable for PAHs and mercury at some labs that have the expertise and special instrumentation (see section VI.B. above for examples).

If the natural resources at or near the site are particularly sensitive, pristine, or important to the Park, the Superintendent may wish to choose the strictest available standard or criteria as the remediation goal. He/she would then have to request some lower DLs (lower than those in Table 3) from the lab for PAHs and mercury.

For the contaminants in Table 1 that are not listed in Table 3, commonly reported DLs are acceptable.

Table 3: Maximum acceptable detection limits ("reporting limits") for surface water, groundwater, soil, and sediment samples. Lower detection limits are also acceptable.

| Contaminant | Detection limit for surface water and groundwater samples | Detection limit for soil and sediment samples (dry weight) |
|---|---|---|
| PAHs | 10 ppt [a] | 1 ppb [c] |
| TPH | 50 ppb | 0.1 ppm |
| benzene | 1 ppb | 25 ppb |
| toluene | 5 ppb | 25 ppb |
| ethylbenzene | 5 ppb | 25 ppb |
| xylene | 5 ppb | 25 ppb |
| ammonia | 0.05 ppm | -- |
| arsenic | 5 ppb | 0.5 ppm |
| barium | 1 ppb | 1 ppm |
| cadmium | 0.5 ppb | 0.2 ppm |
| chromium | 3 ppb | 1 ppm |
| copper | 5 ppb | 1 ppm |
| iron | 0.1 ppm | 10 ppm |
| lead | 1 ppb | 5 ppm |
| mercury | 0.2 ppb [b] | 0.2 ppm [d] |
| nickel | 5 ppb | 5 ppm |
| selenium | 1 ppb | 1 ppm |
| strontium | 10 ppb | 5 ppm |
| vanadium | 10 ppb | 1 ppm |
| zinc | 10 ppb | 5 ppm |

water units:

ppm = parts per million = milligrams per liter = mg/L

ppb = parts per billion = micrograms per liter = ug/L

ppt = parts per trillion = nanograms per liter = ng/L

soil/sediment units:

ppm = parts per million = milligrams per kilogram = mg/kg = micrograms per gram = ug/g

ppb = parts per billion = micrograms per kilogram = ug/kg = nanograms per gram = ng/g

a - DLs as low as 1 ppt may be achievable

b - DLs as low as 0.1 ppb, or even 10 ppt, may be achievable

c - DLs as low as 0.25 ppb may be achievable

d - DLs as low as 25 ppb, or even 1 ppb, may be achievable

For an extensive list of federal standards and other published environmental criteria for most of the contaminants in Table 1, consult NPS Water Resources Divisions' "Environmental Contaminants Encyclopedia" at the website http://www.aqd.nps.gov/toxic. Note that there may be state standards, other criteria, or in some cases, updated federal standards that are not listed in this Encyclopedia.

# VIII. SAMPLE PLAN AND REPORTING REQUIREMENTS

## A. Sample Plan

The owner/operator should submit a Sampling and Analysis Plan to the Superintendent for approval before samples are collected. The plan must include:

- sampling objectives (such as, “identify contaminants and concentrations involved,” “determine spatial extent of spill,” “determine if remediation is complete,” etc.)
- the contaminating substances being investigated (such as crude oil, natural gas condensate, produced water, etc.)
- list of individual contaminants that will be tested for (see Table 1)
- analytical methods to be used (see section VI. A.)
- type of samples to be collected (such as soil, sediment, groundwater, or surface water)
- citation and brief description of sample collection methodology to be used (see section IV. B.)
- specific sample locations and number of samples at each (Superintendent will walk the site and choose exact locations; this information may not be available until the time when samples are actually collected)
- total number of samples (this information may not be available until the time when samples are actually collected)
- acknowledgment that detection limits (that is, “reporting limits”) specified herein (section VII) will be achieved
- brief description of QA/QC procedures to be followed and citation of any guidance document used (see section V)
- acknowledgment that proper chain-of-custody procedures will be initiated and followed

## B. Reporting Requirements

Upon completing sample collection and analyses, the owner/operator shall submit a report to the Superintendent. This report shall include:

- sample ID number/name
- description of sample locations (include maps, sketches, or photos)
- sample depth
- brief description of spill area (apparent extent of spill, topography, vegetation, surface water features, apparent soil conditions, etc.)
- date and time of sampling
- name of sample collector
- information pertinent to the sample collection methodology used (sampling devices used, how samples were collected, etc.)
- sample containers used, any preservation methods, and storage conditions of samples
- date and time of analyses
- name of chemist/technician performing analyses
- type of sample (soil, sediment, groundwater, or surface water)
- sample fraction measured (such as “total”, “total recoverable”, etc.)
- analytical results and units (mg/kg, µg/L, etc.)
- percent moisture (for soil/sediment samples)
- wet weight *and* dry weight units (for soil/sediment samples)
- analytical methods used

- detection limits (that is, “reporting limits”) achieved
- method detection limits (MDL) for the analytical methods used
- indication of analyses done in the field (such as pH, conductivity, etc.)
- field observations made while collecting samples
- lab and field QA/QC results and procedures followed
- name of analytic equipment used
- appropriate chain-of-custody forms

# IX. SPILL RESPONSE AND NOTIFICATION PROCEDURE FOLLOWING RELEASE OF A CONTAMINATING SUBSTANCE FROM A NONFEDERAL OIL AND GAS OPERATION IN A PARK UNIT

## A. Initial Park Staff Actions Following Discovery of a Release

1. Secure the area to protect human health and safety

2. Notify operator of the release and immediate need to control the source and contain the release, and obtain information of the released substance

3. Initial site assessment to identify park resources potentially as risk from the release (surface water, wetlands, cultural resources, etc.), and quantity of released substance

4. Direct operator during initial spill containment actions to protect natural and cultural resources at risk, and to protect human health and safety

5. Notify Regional Spill Response Coordinator and relay all pertinent information

6. Obtain 5 liter sample of released substance (Note: need preservation and storage guidance for park staff) and initiate chain of custody documentation

7. Continue to oversee operator containment actions and maintain security

8. Park Superintendent advises operator that the operation is immediately “suspended” pursuant to NPS regulations at 36 CFR §9.51(c)(2)

9. Park staff prepares a detailed Case Incident Report on the spill event

## B. Regional Spill Response Coordinator Notification Duties

1. Contact National Response Center to advise of release and obtain case number

2. Notify Environmental Quality Division (Dan Hamson), Geologic Resources Division (Jim Woods), Regional Minerals Coordinator (Linda Dansby), and Water Resources Division (Matt Hagermann) if release threatens water resources

3. Coordinate a conference call with above technical offices and park staff to define appropriate course of action relative to spill containment, public health and safety, site assessment, damage assessment, and operator responsiveness and capability

4. Notify pertinent state regulatory agencies and state trustees

## C. Coordination of Response, Clean-up and Damage Assessment

1. All involved NPS staff track time and all other expenditures associated with the spill event

2. Park Superintendent prepares formal suspension notice for Regional Director's signature in accordance with NPS regulations at 36 CFR §9.51(c)(2)

3. Park staff coordinates with designated On Scene Coordinator (EPA, Coast Guard, or NPS staff expert if EPA or Coast Guard does not dispatch a coordinator) and state regulatory agencies to oversee operator spill response and initial clean-up actions

4. Park staff coordinates with On Scene Coordinator (OSC) and state trustee agencies in the conduct of resource damage assessment (Note: operator may contract with approved consulting firm/laboratory to conduct assessment work)

5. All involved NPS offices evaluate site assessment results and reach consensus on additional remediation actions and reclamation goals, and communicate recommendations to park Superintendent. (Note: NPS regulations at 36 CFR §9.39(a)(1)(i) and §9.39(a)(2)(iii) require operators to remove or neutralize any contaminating substance)

6. Park staff coordinates with OSC and state trustee agencies in monitoring remediation and reclamation actions

7. Park Superintendent and NPS technical working group evaluates final remediation/reclamation success and determines if further legal action against the operator is required (Note: operators are liable for any damages to federally-owned or controlled lands, waters or resources pursuant to 36 CFR §9.51(a).