U. S. Department of Energy
STRATEGIC PETROLEUM RESERVE PROJECT MANAGEMENT OFFICE
New Orleans, LA.

ORDER

SPRPMO O 413.3B

Approved **8/02/21**

SUBJECT: CRUDE OIL QUALITY PROGRAM AND TEST CRITERIA

. PURPOSE. To ensure the continued development of a comprehensive crude oil quality program for Strategic Petroleum Reserve (SPR) inventories and associated testing criteria. It applies to all crude oil acquired for and transported to the SPR; to oil stored or moved within or between Department of Energy (DOE)/ commercial terminals and storage sites; and to oil distributed during testing, exchange, storage, fill and drawdown.

2. CANCELLATION. This Order cancels SPR Project Management Office (SPRPMO) O 413.3A, Crude Oil Quality Program and Test Criteria Order, dated August 18, 2016.

Cancellation of a directive does not, by itself, modify or otherwise affect any contractual or regulatory obligation to comply with the directive. Contractor Requirements Documents (CRDs) that have been incorporated into a contract remain in effect throughout the term of the contract unless and until the contract or regulatory commitment is modified to either eliminate requirements that are no longer applicable or substitute a new set of requirements.

3. APPLICABILITY.

a. SPRPMO Elements. Except for the exclusions in Paragraph 3c, the provisions of this Order apply to all SPRPMO organizational elements.

b. DOE Contractors. Except for the exclusions in Paragraph 3c, the CRD, Attachment 1, sets forth requirements of this Order that will apply to contracts that include the CRD. This Order applies to the Management and Operating (M&O) contractor.

c. Exclusions. None.

DISTRIBUTION: All SPRPMO Offices
M&O Contractor

INITIATED BY:
APM, Maintenance and Operations,
Crude Oil, Drawdown Readiness,
and Cavern Integrity Division

4. REQUIREMENTS. Sampling and testing requirements must be met at each point in the procurement and delivery process where title and/or custody changes, for movements of oil within or between SPR complexes, and for periodic sampling of SPR caverns. Detailed comprehensive sampling and testing requirements are provided in Attachment 1, Appendices 1 through 4. Crude oil quality of SPR inventories shall be ensured by adherence to specific sampling and testing requirements at acquisition, internal movements, drawdown, exchange and storage. The requirements for sampling and testing, retention of samples, and the specific testing methods to be used are addressed in Attachment 1, Appendices 1 through 4.

   This Order provides guidance and direction of crude oil quality testing, responsibilities, requirements, testing methods, sampling, and waiver processes and procedures.

5. RESPONSIBILITIES.

   a. SPR Project Manager.

      (1) Ensures that the SPR has a viable Crude Oil Quality Program.

      (2) Approves all crude oil quality anomalies meeting the following criteria:

         (a) American Petroleum Institute (API) Gravity less than 29 degrees at 60 degrees Fahrenheit.

         (b) Sediment and Water Content exceeding 1.75 volume percent.

         (c) Total Sulfur exceeding 0.75 mass percent for sweet crude oil and 2.25 mass percent for sour crude oil.

         (d) Light Ends content requiring advancement of vapor pressure mitigation by 8 years or more.

         (e) Other crude oil quality anomalies, as deemed necessary.

   b. Assistant Project Manager, Maintenance and Operations.

      (1) Oversees the development and maintenance of the SPR Crude Oil Quality Program and Test Criteria by the Crude Oil Organization

within the Crude Oil, Drawdown Readiness, and Cavern Integrity Division.

(2) Ensures that adequate resources are available for implementation of the Crude Oil Quality Program.

(3) Approves the annual 10-year cavern sampling plan submitted by the M&O contractor.

(4) Approves all crude oil quality anomalies that do not meet the specifications described in Figure 5, STRATEGIC PETROLEUM RESERVE CRUDE OIL SPECIFICATIONS, and not specified in Section 5.a(2),(a)-(d).

c. Director, Crude Oil, Drawdown Readiness, and Cavern Integrity Division.

(1) Develops, interprets, and revises the SPR Crude Oil Quality Control Program and Test Criteria, and evaluates M&O contractor performance in the implementation of this Order.

(2) Prepares appropriate crude oil quality requirements and clauses reflecting SPR policy for inclusion where appropriate in contracts, lease agreements, intra-agency and interagency agreements, and memoranda of understanding for the acquisition, transportation, handling, and storage of SPR crude oil.

(3) Ensures that the Operations and Readiness Office (FE-43), SPR Headquarters, is included in the distribution of all reports that are requested on SPR crude oil quality determinations.

(4) Establishes and publishes the sampling, testing, and quality criteria for SPR crude oil, including test characteristics, specifications, and American Society for Testing and Materials (ASTM)-International test methods required (1) at each custody transfer point; (2) for underground cavern inventories; (3) for management of pressurized, unpressurized, and gas regain sampling programs; and (4) for crude oil sample retention.

(5) Establishes general guidelines for requesting and obtaining crude oil waivers. See Attachment 1, Appendix 4 for Guidelines.

(6) Assures that required funding is included in the SPR budget requests for M&O Contractor Third Party Inspection Laboratory Services

(7) Monitors and evaluates the M&O contractor's Crude Oil Quality Control (QC) Program.

(8) Participates in the negotiation, and monitors implementation of interagency support agreements as necessary to provide services for QC incident to the procurement, transportation, receipt, intra-complex movements, and periodic inventorying of SPR crude oil.

(9) Alters scheduled operations incident to implementation of this Order when such schedule alteration is deemed to be in the best interest of the SPR.

d. Assistant Project Manager, Technical Assurance.

(1) Verifies compliance with PMO-published criteria and procedures by:

(a) Ensuring that contractor crude oil QA programs are adequate and consistent with SPR QA objectives and policy by performing audits and documenting comments for resolution by the contractor and Contracting Officer.

(b) Documenting and informing the Assistant Project Manager (APM), Maintenance and Operations of any crude oil QA deficiencies, reviewing the proposed and implemented corrective actions for adequacy, and ensuring conformance to SPR criteria and requirements. This activity shall be accomplished through the use of documented Quality and Performance Assurance Division procedures and audits.

e. Department of Defense (DOD) Agencies. Under the existing DOE/DOD Interagency Agreement, resources may be required to perform Source Inspections for DOE contracts upon request.

6. REFERENCES.

a. The latest editions of American Petroleum Institute (API) Manual of Petroleum Measurement Standards (MPMS), and American Society for Testing and Materials (ASTM)-International Standards for sampling and

testing of petroleum as outlined in Attachment 1, Appendix 3, Testing Methods.

b. M&O contractor Publication ASI7000.12, Crude Oil Quality and Quantity Control Procedures Manual, current version.

c. M&O contractor Publication MS17000.133, Laboratory Programs and Procedures Manual, current version.

7. CONTACT. Questions concerning this Order should be addressed to the Director, Crude Oil, Drawdown Readiness, and Cavern Integrity Division, [redacted] and/or Crude Oil Management Team, [redacted].

[redacted]
Paul S. Oosterling
Project Manager
Strategic Petroleum Reserve

Attachment:
Contractor Requirements Document

Attachment 1

CONTRACTOR REQUIREMENTS DOCUMENT

SPRPMO O 413.3B, CRUDE OIL QUALITY PROGRAM AND TEST CRITERIA, Dated 8/02/21

Regardless of the performer of the work, the contractor is responsible for complying with the requirements of this Contractor Requirements Document (CRD). The contractor is responsible for flowing down the requirements of this CRD to subcontractors at any tier to the extent necessary to ensure the contractor's compliance with the requirements.

The Strategic Petroleum Reserve (SPR) Management and Operating (M&O) contractor shall:

1. Implement the sampling and testing requirements for crude oil movements incident to procurement, receipts, transfers, drawdown, and sales.

2. Ensure that Contracts are in place with offsite accredited laboratories, to support SPR operations.

3. Maintain and keep current the Crude Oil Sample Management Organizational System (COSMOS). COSMOS is the repository for all crude oil quality data generated from SPR, Terminal, and contracted laboratory analytical data.

4. Conduct a pre-oil movements meeting on site before each crude oil ~~movement~~ cycle to include the Department of Energy (DOE) Senior Site Representative, Site Operations Manager, support departments, and Third Party Inspectors. Pre-oil-movement meetings will be conducted no more than 72 hours prior to the commencement of the first oil movement so the strategy and details are understood by all. Meeting minutes will be prepared and distribution made to applicable parties. A post-oil-movement meeting will be conducted as needed.

5. Submit annually by July 31 for APM for Maintenance and Operations concurrence a 10-year cavern sampling plan. The annual 10-year cavern sampling plan shall include schedule and type of sampling for full cavern, partially full cavern, 10-year, gas regain sampling as well as special tests sampling with explanations for variances from required schedule/methods as well as changes from previous 10-year cavern sampling plan.

Deviations from the 10-year cavern sampling plan shall be submitted to the APM for Maintenance and Operations for approval. Deviations shall include justification based on such information as emergency workovers, drawdowns, exchanges, Royalty-in-Kind fill, expansion, vapor pressure requirements, budgetary constraints, and other emergency or operational considerations.

6. Develop detailed programs, sampling and testing plans, manuals, and operating procedures as necessary.

7. Maintain electronic and hard copy files of SPR data generated by the contracted laboratory.

8. Develop fluid movement procedures for all crude oil movements in accordance with DOE Conduct of Operations, Chapter 16.

9. Develop and implement the pressurized, unpressurized, and gas regain sampling programs.

10. Ensure quality compliance for suitability of cavern injections and proper approval for any off-site disposal.

11. Request DOE concurrence to upgrade/downgrade crude oil at least 2 workdays prior to occurrence. The written request must include justification and cost analysis on alternatives.

12. Request DOE concurrence on all crude oil quality anomalies.

13. All crude oil deviation waiver requests must be submitted formally in writing to DOE within two work days of initial request. At time of occurrence, a verbal (telephone) waiver request or e-mail is acceptable.

14. Maintain required records on all crude oil quality anomalies and upgrade/downgrade requests requiring DOE concurrence. Data should include site, cavern number and associated barrels, crude type/grade, and date of occurrence.

15. Provide training, as required, for operations, maintenance, and warehouse personnel involved with implementation of this Order at all SPR oil handling and storage facilities and laboratories.

16. Arrange for transport of samples from the terminal, between SPR sites, and to outside contractors.

17. Ensure crude oil auto in-line sampling containers are cleaned no more than 4 hours prior to an oil receipt. Crude oil in sampling containers will be collected within 2 hours after completion of an oil movement.

18. Ensure that crude oil samples are properly labeled to include; crude type, sample location, sample type, purpose, and date.

19. Maintain detailed records as necessary to provide a data bank of actions accomplished in the execution of this program, and the results of those actions.

20. Maintain records necessary to provide a comprehensive database on SPR crude oils that will include the following and such other data elements as appropriate:

    a. Cavern sampling schedules by site and cavern.

    b. Sampling accomplished to date.

    c. Results of all analyses performed.

21. Maintain the *Crude Oil Quality and Quantity Control Procedures Manual*, Publication ASI 7000.12, current version.

22. Maintain the *Laboratory Programs and Procedures Manual*, Publication MSI 7000.133, current version.

23. Maintain the Third Party Inspection Sampling contract and provide support for the Crude Oil Assay testing contract.

APPENDICES:

Appendix 1 – Types of Samples
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APPENDIX 1
TYPES OF SAMPLES

1. FILL SAMPLES (VESSELS, PIPELINES, TANKS).

   a. Sampling Requirements.

      (1) Prior to receipt, obtain a representative sample of the cargo.

      (2) Quality shall be determined by samples taken from (1) automatic in-line samplers, (2) shore tanks receiving the oil, or (3) ship's composite tank sample.

      In the case where a sample is to be collected via an in-line sampler, the sample retrieved will represent the entire cargo or shipment. If the size of the delivery is such that more than one composite sample is necessary, the individual samples will be labeled appropriately (for example, 1 of 2) and annotated as to the number of barrels of crude represented by each sample. A proportionate share of each sample shall be blended into a composite sample for testing.

   b. Testing Requirements.

      (1) Samples taken will be tested for the following prior to receipt: API Gravity and Sediment and Water (ASTM D4007) is acceptable for this determination). Upon receipt of these results, approval is given to commence delivery on the basis of the shipment meeting quality criteria. Otherwise, a waiver to those criteria must be obtained. Organic Chlorides, Elemental Analysis, and Sulfur will be determined prior to cavern injection.

      (2) The sample(s) collected in accordance with Section 1.a. (2) above will have the following tests performed: API Gravity, Sediment and Water, Sulfur, and NORM.

2. SPR CRUDE OIL MOVEMENT SAMPLES.

a. Terminal Tankage.

(1) Sampling Requirements. Samples are to be taken before and after introduction of SPR crude into terminal tanks. The "opening" sample is an all-level tank sample taken and analyzed prior to introduction of the SPR crude cargo. The "closing" sample is an all-level tank sample taken after introduction of the SPR crude cargo.

(2) Testing Requirements. The opening and closing samples will be analyzed for API Gravity, Sulfur, and Sediment and Water (ASTM D4007 is acceptable for this determination).

(3) Sampling and Testing for Hydrogen Sulfide (H_2S). In the event H_2S concentrations are required to be submitted in support of delivery operations (e.g. vessel loading), sampling and testing shall be performed in accordance with published industry standards.

i. For H_2S in liquid, UOP 163 (current edition) method or ASTM D3227 (current method) for sampling, handling, and analysis shall be utilized.

ii. For H_2S in vapor, ASTM D5705M (current edition) method for sampling, handling and analysis shall be utilized.

Note: Other industry standard methods for sampling, handling, and analysis may be utilized in addition to, or in lieu of, aforementioned methods as new or improved procedures are developed and implemented.

b. Intersite Movements.

(1) Sampling Requirements. Composite samples from in-line samplers will be required during movements of crude oil between SPR sites/terminals. "Shipment" samples (those samples taken where the crude oil delivery originates) will be distinguished from "receipt" samples (those samples taken where the crude oil delivery terminates).

Note: When in-line samplers are not available, or become inoperable, beginning, middle, and end samples, or tank composite samples may be substituted to fulfill this requirement.

(2) Testing Requirements. Shipment samples will be analyzed for API Gravity, Sulfur, and Sediment and Water (ASTM D4007 is acceptable for this determination).

Receipt samples are high priority and analyses must be performed as soon as feasible after they are received at the crude oil laboratory. Analyses to be performed include, organic chlorides, elemental analyses, NORM, and limited inspection analyses including API Gravity, Sulfur, and Sediment and Water (ASTM D4007 is acceptable for this determination).

c. Intrasite Movements.

(1) Sampling Requirements. Representative samples will be required during any movement of crude oil within an SPR site exceeding 10,000 barrels. Tank-to-tank, cavern-to-cavern, or tank-to-cavern movements are examples of intrasite movements.

(2) Testing Requirements. Limited inspection analyses will be conducted, including API Gravity, Sulfur, and Sediment and Water (ASTM D4007 is acceptable for this determination).

NOTE: An intrasite movement sample may constitute a sample of opportunity if the sampling requirements in Section 3.c. (1) have been satisfied. Sampling and testing for samples of opportunity will be performed in accordance with Section 3.c. (2).

3. CAVERN SAMPLES.

a. The M&O contractor will submit annually, by July 31, a 10-year cavern sampling plan to the APM for Maintenance and Operations for concurrence. The annual 10-year cavern sampling plan shall include schedule and type of sampling for full cavern, partially full cavern, 10-year, gas regain sampling as well as special tests sampling with explanations for variances from required schedule/methods as well as changes from previous 10-year cavern sampling plan.

Analysis of the historical cavern sampling data collected during long periods confirms that the frequency of 8 – 12 years for cavern sampling is accurate, and is sufficient from a time perspective. Cavern crude oil quality stability is

observed under the SPR cavern storage conditions during these periods and longer. Recently, cavern compositional changes as a result of Fill, Exchanges, and Sales may substantiate that additional or more frequent sampling of caverns may be required.

Additional factors are considered which impact the timing of cavern sampling. Oil fill injections into caverns requires sufficient time to allow for adequate mixing. In order to obtain representative and valid samples of the caverns, a minimum of 180 days following an oil cavern injection (exceeding either 1 million barrels or approximately 25% of the cavern oil inventory) is required.

Another factor considered in the timing of cavern sampling is the "Sample of Opportunity". Cavern workover rigs used in cavern sampling are costly, and when an opportunity arises in which a cavern workover rig will be used at a later time on a cavern for another activity, a determination is made whether to delay the cavern oil sampling and perform the sampling in conjunction with the other cavern workover activity; and thereby avoiding duplication of costs.

Based on the above, the time span between cavern sampling can vary, and may exceed the established sampling plan frequency in order to maximize the results and control costs. This may be influenced by workover and/or degas operations. However, such deviation must be approved by the APM – Maintenance and Operations as a part of the annual sampling plan review.

Deviations from the 10-year cavern sampling plan shall be submitted to the APM Maintenance and Operations for approval. Deviations shall include justification based on such information as emergency workovers, drawdowns, oil fill, exchanges, Royalty-in-Kind (RIK) fill, expansion, vapor pressure requirements, and other emergency or operational considerations.

Top-to-Bottom Crude Oil Cavern Inventory Sampling.

Full Cavern Sampling: An initial or baseline top-to-bottom sampling of full caverns will be accomplished not sooner than 180 days after completion of fill or during the workover of the West Hackberry Phase II caverns. This allows for settling of sediment and water and establishment of a sharp oil/brine interface.

Refilled Cavern Sampling: APM for Maintenance and Operations will determine if top-to-bottom fill sampling will be repeated for a previously full cavern that has been drawdown and refilled with a significant percentage of new crude oil based on information and recommendation provided by the M&O contractor.

Partially Full Cavern Sampling: If a partially filled cavern is to remain static for more than 180 days, the M&O contractor will submit a recommendation on sampling of the cavern to the APM for Maintenance and Operations for his concurrence.

Ten-Year Sampling: Cavern sampling will be repeated approximately once every 10 years following the previous top-to-bottom sampling. This cycle is established to 1) ascertain the stability of crude oil quality under cavern storage conditions on a periodic basis, and 2) to balance the number of cavern sampling events per year to between 6-7 (ideally) and 4-9 (acceptable). The 10-year cycle for any individual cavern will be adjusted to between 8-12 years in order to achieve these objectives. Typically, samples taken from any given cavern will include samples from the crude oil and the sludge phase, as well as a brine sample as described below (except as instructed in 3.a.(1)(b), Caverns Scheduled to be Degassed).

> Note: Caverns with insufficient historical data to accurately verify the approximate thickness of the sludge layer will be subject to individual assessment. The historical data for these caverns will be evaluated and may require additional sampling in the interface region to achieve a more accurate assessment of the potential sludge layer thickness.

Subsequent multi-year samplings of a cavern's inventory normally will not be conducted within a minimum of 180 days following an oil injection greater than 1 million barrels into that cavern.

> Note: Single well cavern sampling shall be coordinated with other workover operations and may be done on other than a 10-year cycle. However, if no well workover occurs on a single well cavern in a 10-year period, a workover will be performed for the sole purpose of obtaining top-to-bottom samples (except as instructed in 3.a.(1)(b), Caverns Scheduled to be Degassed).

When a top-to-bottom sample is performed, two gallons will be obtained for each layer that is tested. One gallon portion will be retained at the Big Hill

SPR Crude Oil Sample Repository and the other gallon portion will be shipped to the DOE contracted laboratory.

The sampling M&O SMTR or his designee will determine if the sample is considered sludge, and advise DOE accordingly. The sludge samples will be shipped to and retained at the SPR Big Hill Crude Oil Sample Repository as well as shipped to contracted laboratories for analysis.

SHIPPING INSTRUCTIONS AND DIRECTIONS TO DOE CONTRACTED LABORATORY

A 1-gallon portion of each of the crude oil, sludge, and brine samples are to be packaged and shipped to:

Shipping Address:

Core Laboratories
201 Deerwood Glen Drive
Deer Park, TX 77536

Prior to the samples leaving the SPR site, contact the laboratory and also provide the driver with the contact information so he can contact the laboratory when he is within 1 hour of arrival. The contact information is as follows:

Contact Information:

1st Option
Dan Carlson
Main: 281-478-1300
Office: 281-478-1327
Email: Dan.Carlson@corelab.com

2nd Option:
Jennifer Titterington
Main Office: 281-478-1300
Office: 281-478-1322
Email: Jennifer.Titterington@corelab.com

3rd Option
Larry Scott
Main: 281-478-1300
Office: 281-478-1322

SHIPPING INSTRUCTIONS AND DIRECTIONS TO THE BIG HILL SITE

The remaining 1-gallon portion of each of the crude oil, sludge, and brine samples are to be packaged and shipped to the Big Hill site to be stored in the SPR Crude Oil Sample Repository. The two 1-quart samples from each layer are to remain on the site where they were collected with one quart going to the M&O Contracted Third Party Inspection Service (non-assay) laboratory for analysis and the other to the site crude oil retention facility.

Shipping Address: SPR Big Hill Site
24784 Big Hill Road
Winnie, TX 77665
ATTN: Property

A copy of the contracted laboratory's test results will be forwarded to DOE PMO, Program Office and to the M&O contractor for inclusion in the crude oil quality data base.

(1) Unpressurized Crude Oil Samples.

(a) Sampling Requirements. The API gravity, temperature, and description of sample (oil, sludge, or brine) will be recorded at each depth. A 10-liter sample (minimum) will be collected at each crude oil sampling level and divided into two 1-gallon samples and two 1-liter samples. One gallon will be shipped to the SPR Big Hill site, and one gallon will be sent to the contracted laboratory for assay analyses. One liter will be tested by M&O Contracted Third Party Inspection Service Laboratory normally utilized by site for operational analysis (not DOE contracted assay laboratory), and one liter will be retained at the cavern sampling site.

1) A density tool will be run for the unpressurized sampling to locate the depth of the hydrocarbon brine interface* and also to determine the depth to the top of the cavern.

Following determination of the interface* depth, obtain two 1-gallon brine samples from 2 feet below the interface, as well as two 1-gallon samples and two 1-liter

samples approximately six inches (6”) above the interface.

*Interface is defined as the finite depth in the cavern where the water/brine (aquatic) layer meets the sludge/crude oil (hydrocarbon) layer.

2) One 10-liter crude oil sample from 2-feet above the interface.

3) Continue to obtain crude oil samples at 5-foot intervals until API gravity is greater than or equal to 25 degrees API at 60 degrees Fahrenheit. Collect one sample 25 feet above the level where $\geq$ 25 API at 60 degrees Fahrenheit is reached, then obtain an additional five samples, more or less evenly spaced, above the last sample level (25-foot sample) and to include the top of the cavern (approximately 15 feet below the bottom of the chimney).

(b) Caverns Scheduled to be Degassed

1) Caverns being degased which achieve full mixing and do not exhibit “plug-flow” will be sampled as close to the end of degas as is reasonably possible (within the last week). Twelve one-gallon and two one-quart samples will taken at the inlet side to the degas unit. Six of the one-gallon samples will be shipped to the Big Hill Sample Repository and six will be shipped to Core Lab, Deer Park, TX (see **SHIPPING INSTRUCTIONS** above)

2) Caverns being degassed and exhibiting plug-flow require no downhole sampling. There will be no samples taken from the brine, interface, or sludge layers.

3) There will also be no mid-level samples collected for regain (bubble point) testing. The regain data from the TVP-2000 at the inlet to the degas unit will be utilized for this determination

4) Caverns not exhibiting plug-flow, that require a work-over rig to sample shall be sampled immediately following completion of degas operation unless circumstances exist rendering the process support equipment (i.e. workover rig) unavailable.

(c) Testing Requirements.

1) M&O Contracted Third Party Inspection Services Laboratory: Each oil sample will undergo limited inspection analyses, including API Gravity, Sulfur, and Sediment and Water.

2) Contracted Assay Laboratory: A composite of oil samples determined to be outside the sludge layer is made for comprehensive analyses Chapter V, Section 6. However, 10-Year flow samples collected in association with degas will be a composite from the six one-gallon samples (see 3.a (1) (b), Caverns Scheduled to be Degassed). Sludge samples will undergo other characterization testing Chapter V, Section 8.

3) Contracted Assay Laboratory: Brine samples will be shipped to the contracted laboratory for testing deemed necessary to interpret the results of the analyses of overlying crude oil or sludge samples.

b. Pressurized Crude Oil Samples.

(1) Sampling Requirements. Downhole pressurized sampling will consist of five 10-liter pressurized samples taken at mid-depth of the cavern oil. The sampling tool will be run in conjunction with a density tool to locate the oil brine interface and the top of the cavern.

(2) Testing Requirements. Four of the 10-liter pressurized samples collected at mid-depth will be analyzed on site for bubble point pressure and gas composition by an APM-approved bubble point measuring device. The fifth 10-liter pressurized sample will be analyzed on site for the gas/oil ratio and for the Benzene, Toluene, Ethylbenzene, Xylene (BTEX) in the sample vapor. The bubble point

pressure at 100 degrees Fahrenheit will normally be measured, but a higher temperature may be necessary for some crudes or conditions.

c. Samples of Opportunity.

(1) Sampling Requirements. A sample will be collected when a minimum of 100,000 barrels are moved, and a minimum of 6 months lapsed since the last sampling.

(2) Testing Requirements. The samples will be analyzed for API Gravity, Sulfur, Sediment and Water (ASTM D4007 is acceptable for this determination), and NORM.

4. CRUDE OIL ON-SITE TANK SAMPLES.

a. Oil Recovery Tanks, Frac Tanks, and Vacuum Trucks in Oil Recovery Service.

(1) Sampling Requirements. If an SPR site is not equipped with on-site oil recovery equipment, analyses must be completed and reviewed before transfer to permanent cavern storage can proceed; however, transfer to collecting vessels (for example, vacuum truck to oil recovery tank) is permitted after sampling but prior to testing/analyses. If oil recovery equipment is stationed on-site, transfer to permanent cavern storage is permitted after it has been determined that the API Gravity and Sediment and Water content comply with the criteria established below. The remaining analyses will be performed and forwarded to the M&O contractor promptly.

(2) Testing Requirements. The samples will be analyzed for API Gravity, Sulfur, and Sediment and Water (ASTM D4007 is acceptable for this determination). These samples are considered high priority and analyses must be performed as soon as feasible.

Oil recovered and injected into long-term storage shall have a minimum API Gravity of 15 degrees at 60 degrees Fahrenheit and a maximum sediment and water content of 25 percent. The results of the analyses and the implications of the quantities involved will determine the disposition of the material. If the recovered oil is declared unsuitable for injection into a cavern, DOE must give approval prior to any off-site disposal.

Note: Events in which samples are unobtainable will be addressed on a case by base basis. Utilization of an alternate process for quality determination will require DOE concurrence.

b. Monthly Inventory Tank Samples.

(1) Sampling Requirements. At the end of each month coincident with inventory determination, an all-level sample of SPR-owned crude oil in DOE/commercial terminal and site tanks will be taken.

(2) Testing Requirements. Only limited inspection analysis will be conducted, including API Gravity, Sulfur, and Sediment and Water (ASTM D4007 is acceptable for this determination).

5. GAS REGAIN SAMPLES.

a. Sampling Requirements. Besides the 10-year cavern sampling program that includes pressurized sampling for bubble point testing, there is an additional requirement for pressurized samples to satisfy the gas regain testing program. This is consistent with the need to obtain samples for quantifying the gas intrusion rate into each cavern and forecast the need for future degasification.

Cavern pressurized sampling will be scheduled and conducted to fulfill the requirements of both 10-year unpressurized and gas regain sampling simultaneously.

All SPR caverns (except empty caverns) will be evaluated annually and based on the annual gas regain evaluation determination will be made as to which caverns need to be sampled for regain during the following year.

Although in-cavern downhole sampling is preferred, surface flowing samples associated with a sufficient cavern oil movement (minimum of 100,000 barrels) to provide a representative sample of the oil in the cavern may be allowed to determine the gas content of the bulk of the individual cavern's oil with approval of the APM for Maintenance and Operations. Opportunities to obtain such samples shall be evaluated with all significant oil movements at SPR sites.

In-cavern and flowing sampling to perform validation and calibration of the degas plant and associated testing equipment shall require approval of the APM for Maintenance and Operations.

b. Testing Requirements: The pressurized crude oil from either the flow test or the five downhole 10-liter samples will be processed by an APM-approved bubble point measuring device. The bubble point pressure and gas composition at 100 degrees Fahrenheit will be obtained from four of the 10-liter downhole samples. The Gas-to-Oil Ratio (GOR) and BTEX in the sample vapor will be analyzed on the fifth 10-liter sample.

6. SPECIAL SAMPLING - A new assay will be performed on any crude oil that has not been received into the SPR within the previous 3 years.

Note: Sampling other than described above may be necessary at times to satisfy special requirements or situations not covered by this document. Any deviations will be determined on a case-by-case basis through the APM for Maintenance and Operations.

APPENDIX 2
SAMPLE RETENTION

1. SAMPLE RETENTION - All crude oil samples (with the exception of gas regain samples) will be retained as follows:

   The 1-quart sample retains associated with receipts, deliveries, intra and inter site transfers, tanks, frac tanks, slop oil, and multilayer cavern sampling will be retained for a minimum period of 60 calendar days not to exceed 120 calendar days.

   The 10-year one-gallon cavern samples from each layer of the cavern will be shipped to the Big Hill SPR Crude Oil Sample Repository where they will be retained until the next sampling cycle has been completed.

   Upon the expiration of the retention period of the samples, the crude oil shall then be returned to cavern inventory.

   The retention requirements for the 1-gallon samples shipped to the DOE contracted laboratory are governed by the contract between the laboratory and DOE.

APPENDIX 3
TESTING METHODS

1. TESTING METHODS - The preferred method for each test is the "Primary Method" (PM) and will be used in all instances, except where such test method cannot be performed with available equipment. In such instances, the capability of available equipment will determine the equivalent, or "alternate method" (AM) that will be used. Most current test method revisions shall be utilized.

2. QUANTITY DETERMINATIONS - GAUGING, METERING, SAMPLING, AND TEMPERATURE MEASUREMENT – Crude oil samples from an automatic in-line sampler will be immediately collected upon completion of an oil movement. Crude oil samples collected on site during off-duty hours will be held for analysis until the next business day in the site laboratory.

   a. MPMS Chapter 3.1A – Standard Practice for the Manual Gauging of Petroleum and Petroleum Products.

   b. MPMS Chapter 3.1B – Standard Practice for Level Measurement of Liquid Hydrocarbons in Stationary Tanks by Automatic Tank Gauging.

   c. MPMS Chapter 12.2 – Calculation of Liquid Petroleum Quantities Measured by Turbine or Displacement Meters.

   d. ASTM D4057 (MPMS Chap 8.1) – Standard Practice for Manual Sampling of Petroleum and Petroleum Products.

   e. ASTM D4177 (MPMS Chap 8.2) – Standard Practice for Automatic Sampling of Petroleum and Petroleum Products.

   f. API MPMS 7 Manual of Petroleum Measurement Standards Chapter 7 – Temperature Determination.

   g. ASTM D1250 (API STD 2540) (MPMS Chap 11.1) – Standard Guide for Use of the Petroleum Measurement Tables; API Std 2540 Volume Correction Factors - Volume I - Table 5A: Generalized Crude Oils, Correction of Observed API Gravity to API Gravity at 60°F. Table 6A: Generalized Crude Oils, Correction of Volume to 60°F Against API Gravity at 60°F.

3. INSPECTION ANALYSIS.

a. API Gravity

ASTM D1298 (PM)/(API MPMS Chapter 9.1) – Standard Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method.

ASTM D5002 (PM) – Standard Test Method for Density and Relative Density of Crude Oils by Digital Density Analyzer.

ASTM D287 (AM) – Standard Test Method for API Gravity of Crude Petroleum and Petroleum Products (Hydrometer Method).

NOTE: For viscous sludge and slop oil samples, it may be necessary to use a pycnometer bottle to determine density.

b. Total Sulfur

ASTM D4294 (PM) – Standard Test Method for Sulfur in Petroleum and Petroleum Products by Energy-Dispersive X-Ray Fluorescence Spectroscopy.

ASTM D1552 (AM) – Standard Test Method for Sulfur in Petroleum Products (High Temperature Method).

ASTM D2622 (AM) – Standard Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-Ray Fluorescence Spectrometry.

c. Pour Point

ASTM D97 (PM) – Standard Test Method for Pour Point of Petroleum Oils.

d. Viscosity, Saybolt Universal

ASTM D445 (PM) – Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity).

e. Salt Content

ASTM D6470 (PM) - Standard Test Method for Salt in Crude Oils (Potentiometric Method).

ASTM D3230 (AM) - Standard Test Method Salts in Crude Oil (Electrometric Method).

f. Sediment and Water

The water and sediment content results will be listed separately on the DD Form 250, Material Inspection and Receiving Report.

ASTM D473 (PM) - Standard Test Method for Sediment in Crude Oils and Fuel Oils by the Extraction Method.

ASTM D4807 (AM) - Standard Test Method for Sediment in Crude Oil by Membrane Filtration.

ASTM D4006 (PM) - Standard Test Method for Water in Crude Oil by Distillation.

ASTM D4928 (PM) - Standard Test Methods for Water in Crude Oils by Coulometric Karl Fischer Titration.

ASTM D4007 (AM) - Standard Test Method for Water and Sediment in Crude Oil by the Centrifuge Method (Laboratory Procedure).

g. Total Acid Number (Neutralization Number). To be determined on an "as-needed" basis.

ASTM D664 (PM) - Standard Test Method for Acid Number of Petroleum Products by Potentiometric Titration.

f. Hydrogen Sulfide in vapor and liquid,

ASTM D5705M (PM) – Measurement of Hydrogen Sulfide in the Vapor Phase.

UOP 163 (PM) - Hydrogen Sulfide and Mercaptan Sulfur in Liquid Hydrocarbons by Potentiometric Titration.

4. CHLORIDES, ORGANIC. ASTM D4929, Standard Test Methods for Determination of Organic Chloride Content in Crude Oil.

   Detection Limit. The reanalysis notification level for Organic Chlorides is 10 parts per million (ppm).

5. NATURALLY OCCURRING RADIOACTIVE MATERIAL (NORM). Alarm thresholds for each of the alphas, betas and gammas are established at three times the background level for each type of radiation.

6. ELEMENTAL ANALYSIS. Determine the concentration of the following elements by Inductively Coupled Plasma (ICP) or Atomic Absorption Spectrophotometry (AA): arsenic, copper, lead, and zinc.

   Detection Limits: Verbal/written notification will be made to DOE on levels exceeding 10 ppm. A waiver request is required on levels exceeding 20 ppm. An investigation and corrective action will be taken on all levels exceeding 20 ppm.

7. COMPREHENSIVE ANALYSIS - The following analyses will be performed and reported in the format shown in Figure 1, SPR Crude Oil Comprehensive Analysis. In addition, a Gas Chromatographic Analyses will be performed and reported in the format shown as Figure 2, SPR Gas Chromatographic Analyses.

   In addition to the comprehensive analyses, a "Quick Turn-Around Comprehensive Assay" test may be performed on an as-needed basis with an expectation of no more than five (5) samples each year. Testing results must be provided within 14 days.

   In some instances, a "Whole Crude" testing assay may be performed in lieu of the Comprehensive Assay for all of the distillation cuts, if an immediate turnaround is deemed necessary. The High Temp Simulated Distillation (HTSD) test will be used for discerning distillation cuts.

   a. Inspection Analyses

      Limited inspection analyses will be conducted, including API Gravity, Sulfur, Pour Point, Viscosity, Water, and Nitrogen, and reported on a form similar to Figure 3, SPR Crude Oil Inspection Analysis.

b. Distillation

ASTM D5236 – Standard Test Method for Distillation of Heavy Hydrocarbon Mixtures (Vacuum Potstill Method).

ASTM D2892 – Standard Test Method for Distillation of Crude Petroleum (15-Theoretical Plate Column).

c. Nitrogen

ASTM D4629 - Standard Test Method for Trace Nitrogen in Liquid Petroleum Hydrocarbons by Syringe/Inlet Oxidative Combustion and Chemiluminescence Detection.

Modified ASTM D5762 - Standard Test Method for Trace Nitrogen in Liquid Petroleum Hydrocarbons by Syringe/Inlet Oxidative Combustion and Chemiluminescence Detection.

d. Carbon Residue

ASTM D4530 - Standard Test Method for Determination of Carbon Residue (Micro Method).

e. Sulfur: Mercaptan and Hydrogen Sulfide

UOP 163 - Hydrogen Sulfide and Mercaptan Sulfur in Liquid Hydrocarbons by Potentiometric Titration.

f. Smoke Point

ASTM D1322 - Standard Test Method for Smoke Point of Kerosene and Turbine Fuels.

g. Naphthalenes

ASTM D1840 - Standard Test Method for Naphthalene Hydrocarbons in Aviation Turbine Fuels by Ultraviolet Spectrophotometry.

h. Freezing Point

ASTM D2386 - Standard Test Method for Aviation Fuels.

i. Cloud Point

ASTM D2500 - Standard Test Method for Cloud Point of Petroleum Products.

j. Cetane Index

ASTM D976 - Standard Test Method for Calculated Cetane Index of Distillate Fuels.

k. Aniline Point

ASTM D611 - Standard Test Methods for Aniline Point and Mixed Aniline Point of Petroleum Products and Hydrocarbon Solvents.

l. Octane Number

Phillips Small Sample Octane Number Methods.

m. Paraffins/Isoparaffins/Aromatics/Naphthenes.

ASTM D5134 - Standard Test Method for Detailed Analysis of Petroleum Naphthas through n-Nonane by Capillary Gas Chromatography.

n. Metals

Modified ASTM D5708 - Standard Test Methods for Determination of Nickel, Vanadium, and Iron in Crude Oils and Residual Fuels by Inductively Coupled Plasma (ICP) Atomic Emission Spectrometry.

o. Hydrogen Sulfide

ASTM D5705M (PM) - Measurement of Hydrogen Sulfide in the Vapor Phase.

FIGURE 1. SPR CRUDE OIL COMPREHENSIVE ANALYSIS

Sample ID _____ Sample No. _____

Laboratory No. _____ Date collected _____ Date reported _____

Sediment by Extraction, mass % _____ **Crude** Water, mass % _____ Salt, mass % _____

Relative Density, 60/60° F		Ni, ppm		RVP, psi @ 100° F	
API Gravity		V, ppm		Acid number, mg KOH/g	
Sulfur, mass %		Fe, ppm		Mercaptan Sulfur, ppm	
Nitrogen, mass %		Cu, ppm		H_2S Liquid Sulfur, ppm	*
Micro Car. Res., mass %		Org. Cl, ppm		H_2S Vapor Sulfur, ppm	*
Pour Point, °C		UOP "K" Factor		Viscosity: 77° F	cSt
Wax, mass %		Asphaltenes, mass %		100° F	cSt

Fraction	Gas	1	2	3	4	5	6	7	Residuum	Residuum
Cut Temp.	C_2 - C_4	C5 - 175° F	175° - 250° F	250° - 375° F	375° - 530° F	530° - 650° F	650° - 850° F	850° - 1050° F	650° F+	1050° F+
Vol. %										
Vol. Sum %										
mass %										
mass Sum %										
Relative Density, 60/60° F										
API Gravity										
Sulfur, mass %										
Mercaptan Sulfur, ppm										
H_2S Liquid Sulfur, ppm										
H_2S Vapor Sulfur, ppm										
Organic Cl, ppm										
Research Octane Number										
Motor Octane Number										
Acid Number, mg KOH/g										
Cetane Index										
Aromatics, Vol. %										
Naphthalenes, Vol. %										
Wax, mass %										
UOP "K" Factor										
Hydrogen, mass %										
Carbon, mass %										
Nitrogen, mass %										
Refractive Index, 60° C										
Viscosity, cSt 77° F										
100° F										
130° F										
180° F										
210° F										
275° F										
Aniline Point, ° C										
Smoke point, mm										
Freezing Point, °C										
Cloud Point, °C										
Pour Point, °C										
Ni, ppm										
V, ppm										
Fe, ppm										
Cu, ppm										
Micro Car. Res., mass %										
Asphaltenes, mass %										

*- Denotes Calculated data. The information presented in this data sheet is provided as a courtesy from the Department of Energy and the Strategic Petroleum Reserve and is for information purposes only. All reported data reflect the best efforts to represent stream characteristics using industry-standard sampling, testing, and reporting technologies. While care has been taken in preparing this stream assay report neither the Department of Energy nor the Strategic Petroleum Reserve makes any representation, warranty or guarantee as to assay information accuracy, reliability, quality, correctness or completeness. Any and all use of this information is the sole responsibility of the user, and the user releases the Department of Energy, the Strategic Petroleum Reserve, and its contractors from any and all claims arising from its use and shall defend and hold the Department of Energy, the Strategic Petroleum Reserve, and its contractors harmless from any third party claims arising from the user's application or use of any part of the published information.

FIGURE 2
SPR Gas Chromatographic Analyses

Sample ID:
Number:

			Distillate fractions, ASTM D2892		
			C_5-175° F Wt. %	175-250°F Wt. %	250-375°F Wt. %
*	Total Paraffins				
	Total Iso-paraffins				
	Total Aromatics				
	Total Naphthenes				
	Unknowns				
	Paraffins	C2			
		C3			
		C4			
		C5			
		C6			
		C7			
		C8			
		C9			
		C10			
		C11			
		C12			
	Iso-paraffins	C4			
		C5			
		C6			
		C7			
		C8			
		C9			
		C10			
		C11			
		C12			
	Aromatics	C6			
		C7			
		C8			
		C9			
		C10			
		C11			
		C12			
	Naphthenes	C5			
		C6			
		C7			
		C8			
		C9			
		C10			
		C11			
		C12			

Debutanization Fraction	
Component	Wt. %
Methane	
Ethane	
Propane	
i-Butane	
n-Butane	
2,2-dimethylpropane	
i-Pentane	
n-Pentane	
C_6+	

From PIAN Analysis of Whole Crude	
Component	Wt. % of crude
Benzene	
Toluene	
Ethylbenzene	
m-Xylene	
p-Xylene	
o-Xylene	

High Temp. Sim. Dist.	
Recovery, Wt. %	°F
1BP:	
5%:	
10%:	
20%:	
30%:	
40%:	
50%:	
60%:	
70%:	
80%:	
90%:	
95%:	
7BP:	
Recovery at °F	Total, Wt. %
180	
380	
480	
650	
800	
1050	
1105	
1328	

*The modified D-5134 gas chromatographic PIAN method used provides for elution and identification of components up to a nominal n-C_{12} (420° F).

Sample No. Log No.	Bottle Label Date Collected	Depth (ft.)	Relative Density D 5002 @ 60/60°F	Gravity °API	Pour Pt. D 5853 °C	Nitrogen D 5782 (Mass %)	Sulfur D 4294/XRF (Mass %)	Viscosity Centistokes, D 445 at 77°F	 at 100°F	Water D 4928 (Mass %)	Acid No. D 664 mg KOH/g	H2S UOP163 ppm Liquid	H2S D5705M ppmVapor

FIGURE 3 - SPR CRUDE OIL INSPECTION ANALYSIS

Date Started _____ Sample ID _____ Date Reported _____

8. GAS REGAIN TESTING - The vapor pressure/bubble point (gas regain) testing methods are outlined in the subcontractor's "Pressurized and Unpressurized Sampling Contract" summary of work.

9. SLUDGE CHARACTERIZATION - Because of the variability in the composition and properties of sludge, a specific characterization program applicable to all sludges cannot be defined. At a minimum, however, the following tests will usually be conducted and the data reported on a form similar to Figure 4, SPR Sludge Inspection Analysis:

   a. Inspection tests as described in Section 3, with the exception of Viscosity and Reid Vapor Pressure.

   b. Nitrogen.

   c. Wax Content, UOP46 Paraffin Wax Content of Petroleum Oils and Asphalt.

   d. Ash Content (ASTM D482 - Ash from Petroleum Products).

   e. Other appropriate analyses, sample volume permitting, may be performed to more fully characterize the sludge.

10. OTHER TESTS AND ANALYSES - Other tests may be necessary from time to time in response to situations which present changes in or creation of new testing requirements. The specific tests will be selected to fit the circumstances surrounding each situation, and will be subject to approval of the APM for Maintenance and Operations or SPR Headquarters, Operations and Readiness Office (FE-43), as appropriate.

FIGURE 4
SPR SLUDGE INSPECTION ANALYSIS

Sample Number _____

Laboratory Number _____

Sample ID _____

Date Collected _____ Date Completed _____

Analysis	Results
Water (Karl Fischer), Mass %, whole sample	
Following analyses performed on whole___ ,or centrifuged* __ sample	
Water (Karl Fischer), Mass % [centrifuged]	
Gravity, specific, @ 60°F/60°F	
Gravity, °API	
Pour Point, °C	
Nitrogen, Mass %	
Sulfur, Mass %	
Salt, lbs/1,000 bbls	
Wax, Mass %	
Acid number, mg KOH/g	
Sediment by extraction, Mass %	
Ash, Mass %	
Asphaltenes, Mass %	

* Centrifuged at 55,400 relative centrifugal force at 40°C for four hours.

APPENDIX 4
WAIVER

1. WAIVER REQUIREMENT - Whenever crude oil test results fall outside the limits set forth in Figure 5, Strategic Petroleum Reserve Crude Oil Specifications, for the sweet or sour crude specified in the underlying contract, a waiver shall be required. Crude oil quality waiver deviations are granted, as needed, on a case-by-case basis, provided that the oil in question will not degrade and/or ultimately impact the SPR crude oil in storage.

2. WAIVER AUTHORITY. - The Contracting Officer has delegated waiver authority for quality deviations to the APM for Maintenance and Operations, who may grant waivers for crude oil quality deviations up to the constraints specified in Section 5.a (2),(a)-(d). Quality deviations found exceeding the constraints specified in Section 5.a (2),(a)-(d) require the approval of the SPR Project Manager as denoted in 5.a (2). Those designated to act on behalf of the APM for Maintenance and Operations in granting waivers are as follows:

   a. Director, Crude Oil, Cavern Integrity and Readiness Division

   b. Crude Oil Management Team (COMT) Crude Oil Marketing Analyst

   In instances when the Project Manager's approval is required, the designated personnel above shall be responsible for obtaining the approval after being notified.

3. WAIVER PROCEDURES.

   a. For oil in question, ensure that duplicate lab analyses are made and results are within ASTM repeatability limits, if established.

   b. Establish that the crude oil in question will not degrade and/or ultimately impact the SPR crude oil in storage.

c. Immediately report all crude oil quality anomalies to the Crude Oil Management Team. Crude oil waiver requests submitted must contain specifics relating to the occurrence, i.e., identify discrepancy, volume, date, receipt/delivery points, site/cavern numbers, and explanation of occurrence. Only one waiver is needed for the same occurrence per cargo movement.

d. Request to upgrade/downgrade crude oil must be submitted in writing to DOE for review and concurrence at least two work days prior to occurrence.

e. Crude oil waiver requests must be submitted in writing to DOE within two work days of initial request. A verbal (telephone) waiver request or e-mail is acceptable at the time of occurrence.

f. DOE concurrence on crude oil waiver requests and upgrades/downgrades must be obtained prior to executing the DD Form 250.

g. A statement that DOE concurrence was given must be included on the DD Form 250. Also, a copy of the waiver request with DOE concurrence must be attached to the DD Form 250.

h. Request for remuneration must be made to the Contracting Officer.

FIGURE 5

STRATEGIC PETROLEUM RESERVE CRUDE OIL SPECIFICATIONS [a] (SPRO MAY 2020) [ε1]

CHARACTERISTIC	SOUR	SWEET	PRIMARY ASTM TEST METHOD [b]
API Gravity [°API]	30-45	30-45	D 1298 or D 5002
Total Sulfur [Mass %], max.	1.99	0.50	D 4294
Pour Point [°C], max.	10	10	D 97
Salt Content [Mass %], max.	0.050	0.050	D 6470
Viscosity [cSt @ 15.6°C], max. [cSt @ 37.8°C], max.	 32 13	 32 13	 D 445
~~Reid Vapor Pressure~~ Vapor Pressure [VPCR4 (100°F) psia (kPa)] [c], max.	9(62.1)	9(62.1)	D 6377
Total Acid Number [mg KOH/g], max.	1.00	1.00	D 664
Water and Sediment [Vol. %], max.	1.0	1.0	D 473 and D 4006, or D 4928
Yields [Vol. %] Naphtha [28-191°C] Distillate [191-327°C] Gas Oil [327-566°C] Residuum [>566°C]	 24-30 17-31 26-38 10-19	 21-42 19-45 20-42 14 max.	D 2892 and D 5236[c]
Light Ends [Liquid Vol. %] [d], max [d,e] Methane (C_1) Ethane (C_2) Propane (C_3)	 0.01 0.1 1.0	 0.01 0.1 1.0	IP 344 or ITM 6008

[ε1] This revision includes a limitation on light ends content (see Footnote [d])

[a] Marketable crude petroleum suitable for normal refinery processing and free of foreign contaminants or chemicals including, but not limited to, pour point depressants, chlorinated and oxygenated hydrocarbons, and lead.

[b] Alternate methods may be used if approved by the contracting officer.

[c] D 7169 data may be provided in requesting conditional acceptance of a crude oil. Distillation data according to D 2892 and D 5236 will still be necessary for final qualification of a crude oil's acceptance.

[d] Light ends content specifications are interim and will be superseded if and when industry standards for light ends evaluation are implemented.

[e] As new methodologies become industry standard, additional methods may be utilized (e.g. D8003).

f Vapor pressure changed to better reflect current domestic crude standards.

NOTE 1: The Strategic Petroleum Reserve reserves the right to refuse to accept any crude oil which meets these specifications but is deemed to be incompatible with existing stocks, or which has the potential for adversely affecting handling.

NOTE 2: The acceptability of any crude oil depends upon any assay typical of current production quality of the stream. Assays typical of current production quality are mandatory for any crude oil not received by the SPR within the last three years. Any crude oil offered to the Strategic Petroleum Reserve that meets these specifications may be subject to additional testing for acceptance.

NOTE 3: All crude oil shipments received by the SPR are tested to ensure they meet specifications. Crude streams found consistently not meeting required specifications will be removed from the list of acceptable crude oils.