U.S. DEPARTMENT OF ENERGY

Strategic Petroleum Reserve Annual Report for Calendar Year 2016

Report to Congress
October 2018

United States Department of Energy
Washington, D.C. 20585

Message from the Secretary

The Secretary of Energy is required[1] to report annually to the President and Congress on the activities of the Strategic Petroleum Reserve. Highlights of the Department's accomplishments are included in the Executive Summary of this report, the *Strategic Petroleum Reserve Annual Report for Calendar Year 2016.*

This report also includes details concerning the physical capacity, type, and quantity of petroleum in the Strategic Petroleum Reserve in 2016, as well as plans for upgrades and major maintenance. The Energy Policy and Conservation Act requires the Secretary to report information on the current withdrawal and distribution rates and capabilities of the Strategic Petroleum Reserve; the history and costs of petroleum acquisitions for the Strategic Petroleum Reserve; and the costs associated with operations, maintenance, management, and planned projects for the Strategic Petroleum Reserve.

This report is being provided to the President and the following members of Congress:

- **The Honorable Michael R. Pence**
  President of the Senate

- **The Honorable Paul Ryan**
  Speaker of the House of Representatives

- **The Honorable Richard Shelby**
  Chairman, Senate Committee on Appropriations

- **The Honorable Patrick Leahy**
  Vice-Chairman, Senate Committee on Appropriations

- **The Honorable Michael B. Enzi**
  Chairman, Senate Committee on Budget

- **The Honorable Bernard Sanders**
  Ranking Member, Senate Committee on Budget

- **The Honorable Lamar Alexander**
  Chairman, Subcommittee on Energy and Water Development
  Senate Committee on Appropriations

[1] Section 165 of the Energy Policy and Conservation Act (42 U.S.C. 6245), as amended

- **The Honorable Dianne Feinstein**
  Ranking Member, Subcommittee on Energy and Water Development
  Senate Committee on Appropriations

- **The Honorable Lisa Murkowski**
  Chairwoman, Senate Committee on Energy and Natural Resources

- **The Honorable Maria Cantwell**
  Ranking Member, Senate Committee on Energy and Natural Resources

- **The Honorable Rodney P. Frelinghuysen**
  Chairman, House Committee on Appropriations

- **The Honorable Nita M. Lowey**
  Ranking Member, House Committee on Appropriations

- **The Honorable Mike Simpson**
  Chairman, Subcommittee on Energy and Water Development
  House Committee on Appropriations

- **The Honorable Marcy Kaptur**
  Ranking Member, Subcommittee on Energy and Water Development
  House Committee on Appropriations

- **The Honorable Diane Black**
  Chairwoman, House Committee on the Budget

- **The Honorable John Yarmuth**
  Ranking Member, House Committee on the Budget

- **The Honorable Greg Walden**
  Chairman, House Committee on Energy and Commerce

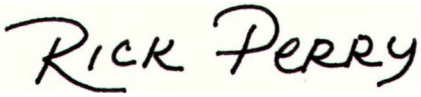
- **The Honorable Frank Pallone, Jr.**
  Ranking Member, House Committee on Energy and Commerce

- **The Honorable Fred Upton**
  Chairman, Subcommittee on Energy
  House Committee on Energy and Commerce

- **The Honorable Bobby L. Rush**
  Ranking Member, Subcommittee on Energy
  House Committee on Energy and Commerce

If you have any questions or need additional information, please contact Mr. Shawn Affolter, Deputy Assistant Secretary for Senate Affairs, Office of Congressional and Intergovernmental Affairs at (202) 586-5450, Mr. Dwayne Bolton, Deputy Assistant Secretary for House Affairs, at (202) 586-5450 or Ms. Bridgette Forcier, Associate Director for External Coordination, Office of the Chief Financial Officer at (202)586-0176.

Sincerely,



Rick Perry

Executive Summary

Program Highlights and Status

The Strategic Petroleum Reserve (SPR) Program provides the United States with energy and economic security through its emergency stockpile of crude oil. The stocks are located at four facilities— Bryan Mound and Big Hill in Texas and Bayou Choctaw and West Hackberry in Louisiana.

The SPR entered 2016 with 695 million barrels (MMbbl) of crude oil, and as of December 31, 2016, the Reserve held 695 MMbbl, equivalent to approximately 145 days of net U.S. petroleum imports, which is a decrease of 37,475 barrels from 2015. The net decrease resulted primarily from the degassing of 42.7 MMbbl of crude oil in calendar year (CY) 2016; this degassing removed impurities from the crude oil. The degasification of 15 out of 21 caverns started in August 2014 at the West Hackberry site and will continue until October 2018.

During 2016, the SPR did not purchase or sell crude oil.

Through the Consolidated Appropriations Act, 2016 (Public Law 114-113), the budget authority for the SPR was $212 million. A total amount of $24.4 billion, net of sales and transfers, has been appropriated for the SPR historically, through Fiscal Year (FY) 2016. Obligations for the SPR in FY 2016 totaled approximately $212.1 million. From this amount, $21.6 million was obligated for Federal program management. The remaining $190.5 million was obligated for contractual goods and services to operate and maintain the SPR and to conduct an emergency drawdown and sale, if required.

In May 2016, the SPR completed the Long-Term Strategic Review (LTSR) in accordance with Section 402 of the Bipartisan Budget Act of 2015 (Pub. L. 114-74). This act required the Secretary of Energy to conduct an assessment of the SPR's ability to carry out its energy security mission in the context of changing North American and global oil markets and its ability to address challenges and critical decisions facing the SPR in the coming years.

Changes to Performance Capabilities

Vapor Pressure Mitigation Program

The Vapor Pressure Mitigation Program continued in CY 2016. The use of deep, underground, solution-mined salt caverns for long-term storage of crude oil subjects the oil to geothermal heating and gas intrusion from the surrounding salt, which tends to increase the crude oil vapor pressure. During a drawdown, oil that is delivered to storage tanks at terminals may release toxic and flammable gases at levels that can present environmental and health risks to terminal personnel and the public. The SPR mitigates the risks posed by toxic and flammable gases

through the use of a customized, portable degasification unit that reduces the crude oil vapor pressure in the caverns so that the crude oil can be delivered safely. The unit is moved among the SPR sites every 2–4 years, as necessary, to degas caverns that show high levels of vapor pressure.

The degas unit continued its five-year program at the West Hackberry, Louisiana site in August 2014. Degasification of crude oil has continued since then with a process total of 42.7 million barrels in CY 2016. Processing of oil through the unit should be completed in the beginning of FY 2019.

Environment, Safety, and Health

The SPR continued to improve safety and health systems throughout the complex during CY 2016. The SPR had another successful year and has improved upon its safety record that was reported for CY 2015. The SPR succeeded in maintaining the lowest SPR accident rate since rates have been recorded with a Total Recordable Rate of 0.46 and a Days Away/Restricted/Transferred (DART) rate of 0.00 for CY 2016. For the second year, the SPR had no work-related injuries that resulted in a DART. The SPR storage sites are recipients of several awards for management quality, environmental stewardship, and safety management systems. In 2016, the SPR was a recipient of an "Electronic Product Environmental Assessment Tool" (EPEAT) award, which recognized organizational excellence in the green procurement of electronics.

In 2016, the SPR received four awards from the Occupational Safety and Health Administration's (OSHA) Voluntary Protection Program (VPP) Region VI, including three Star of Excellence awards for the Bayou Choctaw, Bryan Mound and West Hackberry sites; two Superior Star awards for the Big Hill and Bryan Mound sites; and a Star Among Stars award for the Big Hill site. A Star of Excellence award requires the site to have an incident rate of at least 90 percent below the national average; a Super Star award requires the site to have an incident rate of at least 75 percent below the national average; and a Star Among Stars award requires the site to have an incident rate of at least 50 percent below the national average. The SPR also received awards from the Department of Energy (DOE) VPP.

STRATEGIC PETROLEUM RESERVE ANNUAL REPORT FOR CALENDAR YEAR 2016

Table of Contents

I. Legislative Language

The SPR was authorized by the Energy Policy and Conservation Act (EPCA), as amended (42 U.S.C. 6201 *et seq*.), which was enacted on December 22, 1975 (Pub L. 94-163). The SPR has operated since that time in recognition of the long-term dependence of the United States on imported crude oil and petroleum products.

Section 165 of EPCA, as amended, requires the Secretary of Energy to submit an Annual Report to the President and Congress on the activities of the SPR. Consistent with this statutory provision, this *Strategic Petroleum Reserve Annual Report for Calendar Year 2016* includes information on:

- The status of the physical capacity of the SPR and the type and quantity of petroleum products stored
- An estimate of the schedule and cost to complete planned equipment upgrades or capital investments in the SPR, including upgrades and investments carried out as part of operational maintenance or extension-of-life activities
- Identification of any life-limiting conditions or operational problems at any SPR facility, and proposed remedial actions, including an estimate of the schedule and cost of implementing those remedial actions
- A description of current withdrawal and distribution rates and capabilities, and an identification of any operational or other limitations on those rates and capabilities
- A listing of petroleum product acquisitions made in the preceding year and planned in the following year, including quantity, price, and type of petroleum
- A summary of the actions taken to develop, operate, and maintain the SPR
- A summary of the financial status and financial transactions of the SPR and the SPR Petroleum Accounts for the year
- A summary of expenses for the year, and the number of Federal and contractor employees
- The status of contracts for development, operation, maintenance, distribution, and other activities related to the SPR
- A summary of foreign oil storage agreements and their implementation status
- Any recommendations for supplemental legislation or policy or operational changes the Secretary considers necessary to implement the requirements of the Act.

II. Program Mission

Introduction

The SPR operates pursuant to the authority of EPCA (42 U.S.C. 6201 *et seq.*), as amended. One of the purposes of EPCA was to create an SPR capable of reducing the impact of severe energy supply interruptions.

As of December 31, 2016, the SPR contained 695 million barrels of crude oil. That inventory provides the equivalent of about 145 days of net petroleum imports based on 2016 average net U.S. imports of 4.795 million barrels per day (MMbbl/D). The United States relies solely on crude oil in the SPR to meet its oil stockholding obligations under the Agreement on an International Energy Program, even though private stocks, under specific conditions, can be used to meet the stockholding obligations under the International Energy Program.

Legislative Activity

As required by Section 402 of the Bipartisan Budget Act of 2015, the Secretary of Energy completed a LTSR of the SPR. The LTSR report was transmitted to Congress in August 2016 and released to the public in September 2016. Multiple factors drove the review, including the following:

- Changes in U.S. crude oil production and infrastructure utilization, which has reduced imports and constrained normal distribution pathways for SPR crude
- Surface and sub-surface infrastructure challenges that will fundamentally impact the ability of the SPR to carry out its mission in the coming decades
- Questions about the appropriate inventory level for the SPR in light of projected U.S. oil production
- The Quadrennial Energy Review's (QER) recommendation to analyze the development of larger regional product reserves in the Southeast and Petroleum Administration for Defense District (PADD) V; and the need to review the SPR's legal authorities within the EPCA for the effective management and operation of the SPR.

Three separate laws enacted between November 2015 and December 2016 will directly impact the SPR over the next decade and beyond.

Two sections of the Bipartisan Budget Act of 2015 (Pub. L. 114-74), enacted in November 2015, mandate sales of SPR crude oil. Section 403 requires that the Secretary of Energy (hereinafter "the Secretary") draw down and sell a total of 58 million barrels (MMbbl) of crude oil from the

SPR over 8 consecutive years, commencing in FY 2018 and continuing through FY 2025. Section 404 authorizes the Secretary to sell up to $2 billion worth of crude oil between FY 2017 and FY 2020 to fund a modernization program for the SPR.

The volume of crude oil sold under Section 404 is dependent on annual appropriation amounts and will vary based on the market price for crude oil. The volume could be as high as 80 MMbbl with an average crude oil price of $25/barrel (bbl); 50 MMbbl at $40/bbl; 33.3 MMbbl at $60/bbl; or 26.7 MMbbl at $75/bbl.

Section 32204 of the Fixing America's Surface Transportation Act (the FAST Act) (Public Law 114-94), enacted in December 2015, requires the Secretary to drawdown and sell a total of 66 MMbbl of crude oil from the SPR over three consecutive years, commencing in FY 2023 and continuing through FY 2025.

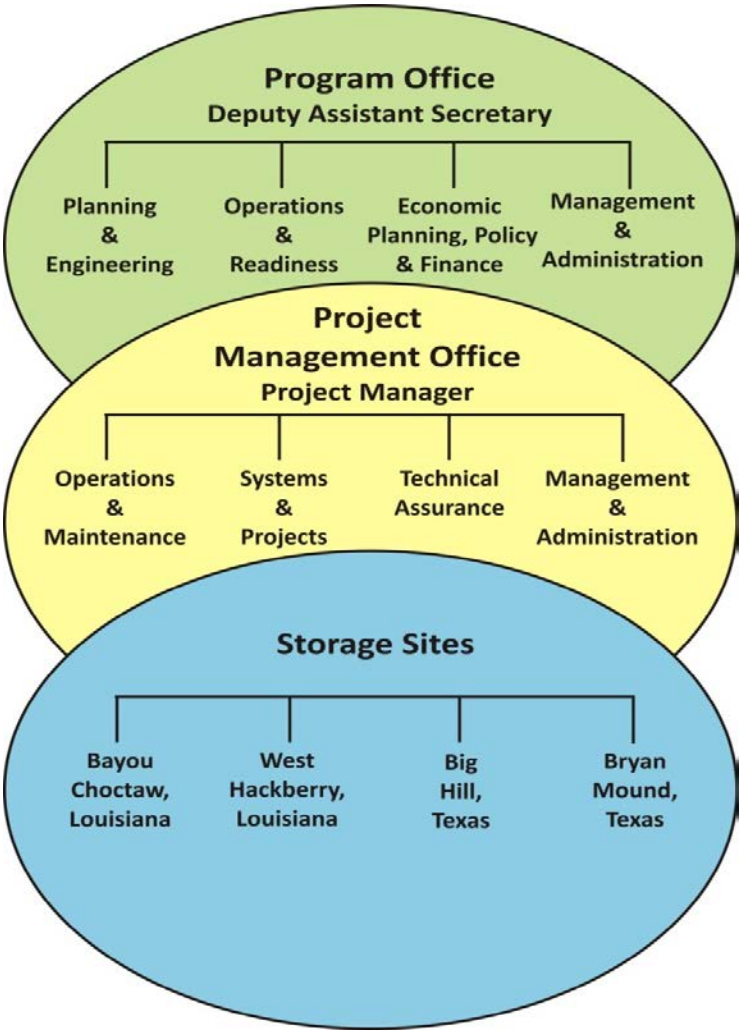
The 21st Century Cures Act (Public Law 114-255), enacted in December 2016, calls for the sale of 25 MMbbl of SPR crude oil for FY 2017 through FY 2019. The first portion of these sales were executed in late spring 2017.

III. Program Management

Organization

The Assistant Secretary for Fossil Energy at DOE in Washington, D.C. has overall program responsibility for carrying out the SPR's mission and for monitoring the SPR's operational readiness capability. This responsibility is delegated to the Deputy Assistant Secretary for Petroleum Reserves and is exercised through the Program Office in Washington, D.C., and the SPR Project Management Office (SPR PMO) in New Orleans, Louisiana. As of December 31, 2016, Program Office staffing was 25 Federal employees and 10 contractor employees, while SPR PMO staffing was 89 Federal employees and 571 contractor employees. Figure 1 depicts the SPR's organizational structure.

Figure 1 : Strategic Petroleum Reserve Organizational Structure



Contractual Support

The SPR PMO is responsible for the design, development, operation, and maintenance of the SPR. Fluor Federal Petroleum Operations serves as the management and operation (M&O) contractor, providing management and personnel to operate and maintain the SPR facilities and related systems. The period of performance for this contract is five years, which began on April 1, 2014, with five one-year options.

Vali Cooper International, a Service-Disabled Veteran-Owned Small Business, is an architectural and engineering firm under contract to provide design services for the four SPR storage facilities. The period of performance is three years, which commenced August 15, 2014.

DOE's Sandia National Laboratory provided geotechnical support that included analysis of the salt domes, cavern integrity, vapor pressure, crude oil quality, and new cavern development.

Several support services contracts exist for management, technical, and computer support. The largest support service contractor was Performance Excellence Partners, a certified 8(a) small disadvantaged business that provided management and technical support through October 31, 2016. Performance Excellence Partners was replaced by Infinity Technology, effective November 1, 2016. The contract with Infinity Technology has a two-year base period with three one-year option periods.

Other support services contractors that provided support to the Program Office in Washington, D.C. in CY 2016 included PB Energy Storage Services, Inc., AOC Petroleum Support Services, LLC, and Cyborg, Inc.

Electrical power is provided to the four storage facilities by local utilities GEXA Energy LP, Reliant Energy Retail Services, LLC, and Entergy Louisiana, LLC.

During CY 2016, the SPR held contracts with three commercial facilities that provided terminal services for fill, drawdown, and storage of crude oil. SPR's contract with Sunoco Partners Marketing & Terminals, L.P. runs through 2018. SPR's five-year contract with Phillips 66 runs through September 2017. SPR's five-year contract with Seaway Crude Pipeline Company concluded December 1, 2016. The SPR entered into a new 5-year contract with Seaway Terminal on December 2, 2016, which will conclude on November 30, 2021.

IV. Crude Oil Storage Program

Strategic Petroleum Reserve Storage Facilities

The SPR currently operates and maintains four major oil storage facilities in the Gulf Coast region of the United States. All oil stored in the SPR's facilities is in large underground caverns that have been created in salt dome formations. Salt dome storage technology provides maximum security and safety for the Nation's stockpile of crude oil and is also the lowest-cost technology for large-scale petroleum storage projects. The average operations cost for FY 2016 was $0.246 per barrel for management, staffing, operations and maintenance, and security. This cost is substantially less than industry storage costs and that of most foreign petroleum oil reserves.

The SPR has two sites in Texas (Bryan Mound and Big Hill) and two sites in Louisiana (West Hackberry and Bayou Choctaw). The four sites have a combined storage capacity of 714 million barrels and a maximum design drawdown capability of 4.415 MMbbl/D[2]. Table 1 shows the design storage capacity and design drawdown capability of each site as of December 31, 2016.

The SPR's oil storage facilities are grouped into three geographical distribution systems in the Gulf Coast: Seaway, Texoma, and Capline. Each system has access to one or more major refining centers, interstate crude oil pipelines, and marine terminals for crude oil distribution. The locations of the SPR storage sites and their respective distribution systems are shown in Figure 2.

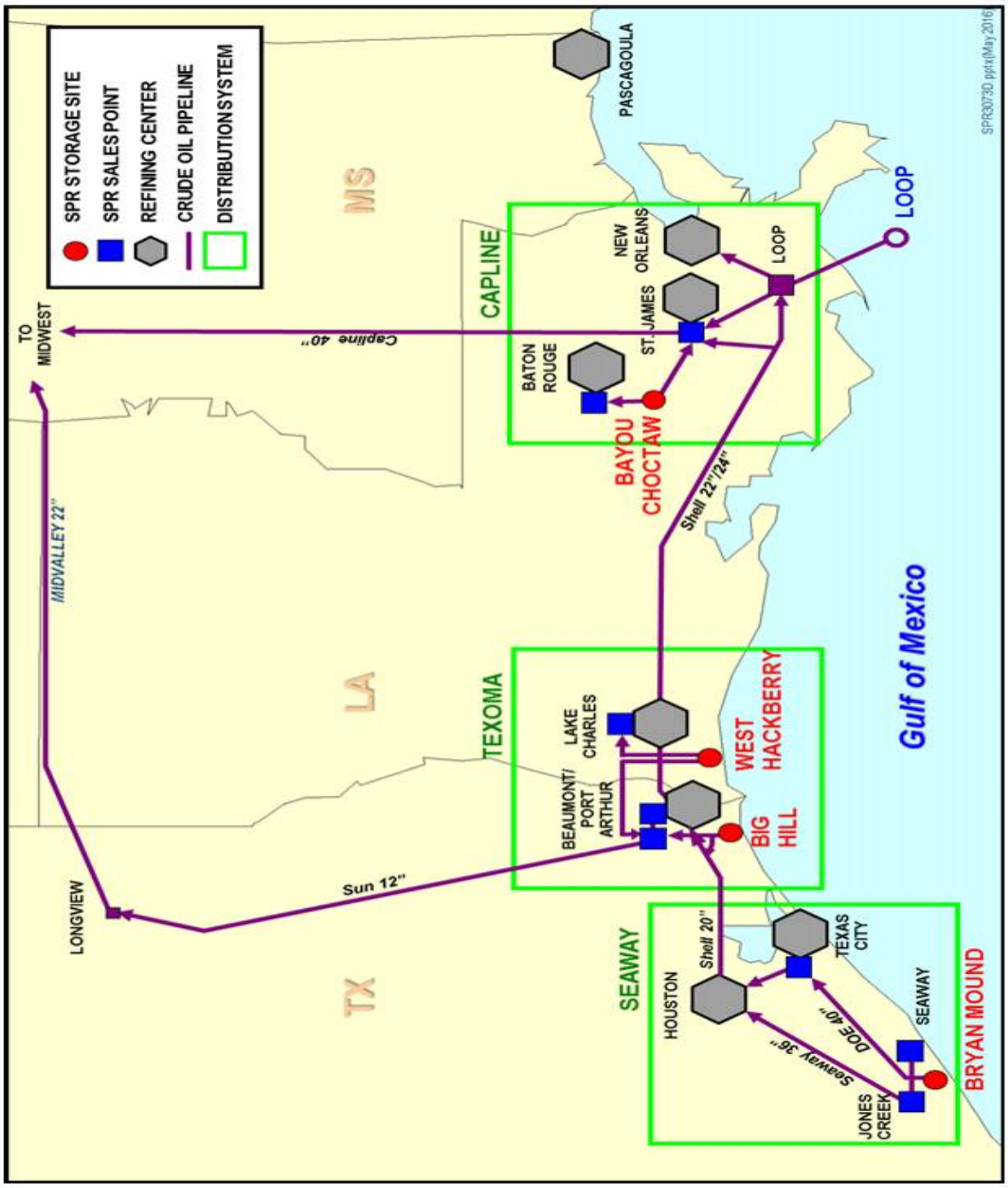
Table 1: Authorized Storage Capacity and Design Drawdown Capability (As of December 31, 2016)

CURRENT SITE CAPABILITY			
Storage Facility	**Design Storage Capacity* (MMbbl)**	**Crude Mix Sweet/Sour (MMbbl)**	**Design Drawdown Capability (MMbbl/D)**
Bryan Mound	**247.0**	**71/176**	**1.5****
West Hackberry	**221.0**	**108/113**	**1.3**
Big Hill	**170.0**	**72/98**	**1.1**
Bayou Choctaw	**76.0**	**24/52**	**.515**
Total Program	**714.0**	**275/439 (39%/61%)**	**4.415[2]**

Sweet = Sulfur content not exceeding 0.5 percent Sour = Sulfur content greater than 0.5 percent
MMbbl = Million barrels MMbbl/D = Million Barrels Per Day
* Storage Capacities reflect Temporary Deviation (VA-D9-054) to minimize oil storage risks in Bayou Choctaw Cavern 20. (i.e., West Hackberry +1.5 MMbbl, Big Hill +1.0 MMbbl, Bayou Choctaw -2.5MMbbl).
** Current Bryan Mound maximum design drawdown capability is reduced to 1.350 MMbbl/D due to needed repair to aboveground storage tank.

[2] Current SPR maximum drawdown capability is reduced to 4.25 MMbbl/D due to a damaged floating pan in Tank 2 at Bryan Mound.

Figure 2: Storage Sites and Distribution System



Cavern Maintenance

During 2016, a total of 20 well workovers were performed at the four SPR sites. This included 16 diagnostic workovers, three remediation workovers to install cemented protective steel liners inside the existing well-bores, and one brine string repair workover. Two workover rigs were used to perform this work, including one leased rig and one DOE-owned rig. A dedicated safety professional is assigned to each rig.

Bryan Mound Site Status

The Bryan Mound storage site is located in Brazoria County, Texas, approximately three miles southwest of Freeport, Texas. As of December 31, 2016, the site had 19 operational storage caverns with a total authorized storage capacity of 247.0 MMbbl, and a cavern inventory of 245.0 MMbbl. During 2016, the site drawdown rate decreased by 150,000 barrels per day (bbl/d) pending replacement of an internal floating pan on a storage tank that is used during drawdown. The storage tank remained out of service for 2016.

Big Hill Site Status

The Big Hill storage site is located in Jefferson County, Texas, approximately 26 miles southwest of Beaumont, Texas. As of December 31, 2016, the site had 14 operational storage caverns, with a combined authorized storage capacity of 170.0 MMbbl, and a cavern inventory of 163.4 MMbbl.

West Hackberry Site Status

The West Hackberry storage site is located in Cameron Parish, Louisiana, approximately 25 miles southwest of Lake Charles, Louisiana. As of December 31, 2016, the site had 21 operational storage caverns with a combined authorized storage capacity of 221.0 MMbbl, and a cavern inventory of 212.4 MMbbl.

Bayou Choctaw Site Status

The Bayou Choctaw storage site is located in Iberville Parish, Louisiana, approximately 12 miles southwest of Baton Rouge, Louisiana. As of December 31, 2016, the site has six storage caverns, an authorized storage capacity of 76.0 MMbbl, and a cavern inventory of 73.6 MMbbl.

The SPR annually performs a number of major maintenance projects each year to maintain the site's operational capabilities.

St. James Marine Terminal Status

The SPR constructed a marine terminal on the Mississippi River at St. James, Louisiana, in the 1970s to support fill and drawdown of the SPR sites. The St. James marine terminal has six aboveground storage tanks with a total storage capacity of two million barrels. The St. James marine terminal was leased to Shell Oil Products US under a lease agreement that was to expire on December 21, 2017, but in 2016 the lease was extended to expire on December 31, 2019. Under the lease agreement, Shell provides for all normal operations and maintenance of the St. James marine terminal and is required to support the SPR as a sales and distribution point in the event of a drawdown.

A connection between the St. James marine terminal and the adjacent Louisiana Capline (LOCAP) terminal enhances the SPR's emergency distribution capabilities by enabling unencumbered crude oil distribution to the LOCAP terminal, the ExxonMobil pipeline, and the Plains terminal.

V. West Hackberry Cavern 6 Transfer Project

As of December 31, 2016, the readily accessible oil has been transferred. Operations will continue to transfer low volumes of any residual crude migrating to the well head. Once this phase is complete, longer-term decommissioning activities will commence.

VI. Bryan Mound Cavern 2 Transfer Project

In 2014, access to the sweet crude oil inventory in Bryan Mound Cavern 2 was considered at risk. Cavern 2 is a two-well cavern. Both Well 2 and 2A failed a Mechanical Integrity Test (MIT) in 2013.

Because of this well history and the associated risk, the decision was made to empty Cavern 2 of crude oil inventory. After the cavern is empty, geotechnical analysis and stabilization of the well will occur. The removal of crude oil out of Cavern 2 began March 1, 2015, as a single closed-loop cavern-to-cavern movement. Oil was transferred from Cavern 2 to receiving caverns within the site. Regulatory requirements will continue to be met during this inventory-withdrawal period.

As of December 31, 2016, all pumpable inventory had been removed from the cavern. Operations will continue to transfer low volumes of any residual crude migrating to the well head. Once this phase is complete, longer-term decommissioning activities will commence.

VII. SPR Modernization Program – Life Extension 2 Project

In 2015, the SPR gained approval for a program that will replace or upgrade site equipment and facilities that are approaching or have exceeded their 25-year life span. This program, named SPR Modernization Program Life Extension 2 (LE2), is being conducted in accordance with DOE Order 413.3B, Acquisition of Capital Assets. Critical Decision 1 was approved in December 2016, with a cost range of $750 million to $1.4 billion. LE2 will upgrade the four SPR storage sites and the St. James marine terminal site.

The LTSR, published in August 2016, includes an assessment of SPR capabilities and infrastructure. It compares current operational capability to Level 1 Technical and Performance Criteria and identifies gaps within the storage site and distribution system infrastructure that must be addressed to ensure a delivery rate of 4.4 million barrels per day over the next 25 years. The results of the LTSR indicate that a significant investment in infrastructure and process equipment is critical to ensuring that the SPR can maintain readiness, meet mission requirements, and operate in an environmentally responsible manner; the SPR LE2 Program will address these requirements.

VIII. Petroleum Acquisition and Exchange

Oil Acquisition Market Assessments

The *Procedures for the Acquisition of Petroleum for the SPR* (10 CFR Part 626) establish the rules and procedures for acquiring SPR crude oil. These procedures require the performance of a comprehensive market assessment prior to initiation or continuation of any oil fill activities to ensure that the SPR acquisition activities will not unduly affect the current market conditions.

Crude Oil Inventory Status

As of December 31, 2016, the SPR's crude oil inventory was 695,081,510 barrels, a decrease of 37,475 barrels from the previous year. The net decrease resulted primarily from the degassing of 42.7 MMbbl of crude oil in CY 2016, resulting in the removal of impurities from the degassed crude oil.

Fill of Reserve

Detailed information about the SPR's fill program since 1977 can be found in the following:

- Table 2 lists year-end inventories and average daily fill rates for the years 1977 through 2016 (by FY and CY).
- Table 3 lists crude oil receipts by country of origin since 1977.
- Table 4 identifies the location of the inventory by storage site, and Figure 3 illustrates the cumulative oil fill by year.

Table 2: Year-End Inventories and Oil Fill History

	FISCAL YEAR		CALENDAR YEAR	
	Year-End Inventory (MMbbl)	Average Daily Fill Rate[1] (Mbbl/D)	Year-End Inventory (MMbbl)	Average Daily Fill Rate[1] (Mbbl/D)
1977	1.1	3	7.2	20
1978	49.1	131	68.5	168
1979	91.2	115	91.7	64
1980	92.8	4	107.8	44
1981	199.2	292	230.3	336
1982	277.9	215	293.8	174
1983	361.0	228	379.1	234
1984	431.1	191	450.5	195
1985	489.3	159	493.3	119
1986	506.4	47	511.6	51
1987	533.9	75	540.6	80
1988	554.7	57	559.5	52
1989	577.1	62	579.9	56
1990	589.6	34	585.7	27
1991	568.5	(58)	568.5	(47)
1992	571.4	8	574.7	17
1993	585.7	39	587.1	34
1994	591.7	16	591.7	13
1995	591.7	*[2]	591.6	*[2]
1996	573.6	(49)	565.8	(70)
1997	563.4	(28)	563.4	(7)
1998	563.4	*[2]	561.1	(6)[3]
1999	564.9	4	567.0	16
2000	570.3	15	540.7	(72)[4]
2001	544.8	(70)[4]	550.2	26
2002	587.2	116	599.1	134
2003	624.4	102	638.4	108
2004	670.3	126[5]	675.6	102[5]
2005	693.7	64[6]	684.5	25[6]
2006	687.8	(16)[7]	688.6	11[7]
2007	692.8	14	696.9	23
2008	702.4	26[8]	701.8	13[8]
2009	725.1	62.2	726.6	67.9
2010	726.5	3.8	726.5	(0.2)[9]
2011	695.9	(84)[10]	695.9	(84)[10]
2012	694.9	(3)[11]	695.3	(2)[11]
2013	696.0	3	696.0	2
2014	691.0	(13.6)[12]	691.0	(13.6)[12]
2015	695.1	11.2	695.1	11.2
2016	695.1	0	695.1	0

Mbbl = Million Barrels Mbbl/D = Thousands of Barrels per Day ( ) = Denotes a Reduction

1. Fill rates adjusted for oil sales
2. Fill suspended during this period
3. Decrease due to Maya exchange
4. Net decrease due to Exchange 2000
5. Net Hurricane Ivan deliveries and receipts
6. Net Hurricane Ivan receipts & Katrina deliveries and receipts
7. Net Hurricane Katrina exchange and drawdown sales
8. Net Hurricanes Gustav & Ike deliveries
9. WH/BC Exchange oil costs and degas loss
10. Drawdown 2011
11. Hurricane Isaac Exchange
12. Test Sale 2014

Table 3: Crude Oil Receipts (As of December 31, 2016)

Source Country	Cumulative (MMbbl)	Percent of Total (%)
Mexico	266.3	31.1
United Kingdom	193.9	22.7
United States*	110.7	12.9
Saudi Arabia	28.3	3.3
Libya	27.5	3.2
Venezuela	25.3	2.9
Angola	25.1	2.9
Russia	25.1	2.9
Iran****	20.0	2.3
United Arab Emirates	19.3	2.2
Nigeria	16.3	1.9
Algeria	15.7	1.8
Cameroon	15.1	1.8
Equatorial Guinea	15.1	1.8
Norway	14.0	1.6
Oman	12.9	1.5
Egypt	8.9	1.0
Ecuador	6.2	0.7
Iraq	3.4	0.4
Gabon	2.4	0.3
Qatar	2.3	0.3
Azerbaijan	2.1	0.2
Columbia	1.2	0.1
Argentina	0.4	0.0
Ivory Coast	0.4	0.0
Peru	0.4	0.0
Total**	858.3***	100.0

MMbbl = Million Barrels
* Included receipts from offshore Gulf of Mexico
** Totals do not add due to rounding
*** Cumulative total receipts unadjusted for sales and operational gains and losses
**** Prior to 1995

Table 4: Crude Oil Inventory (As of December 31, 2016)

Storage Site	Inventory (MMbbl)		
	Sweet*	Sour**	Total***
Bryan Mound, Brazoria County, Texas	68.7	176.3	245.0
Big Hill, Jefferson County, Texas	68.8	94.6	163.4
West Hackberry, Cameron Parish, Louisiana	106.5	105.9	212.4
Bayou Choctaw, Iberville Parish, Louisiana	21.8	51.8	73.6
Subtotal Underground Inventory	265.8	428.6	694.4
Tanks and Pipelines	0.3	0.4	0.7
Total Inventory	266.1	429.0	695.1
Total Accounts Receivable	0.0	0.0	0.0
Total SPR Book Inventory	266.1	429.0	695.1

MMbbl = Million barrels
* Sulfur content not exceeding 0.5 percent
** Sulfur content greater than 0.5 percent
*** Totals do not add due to rounding

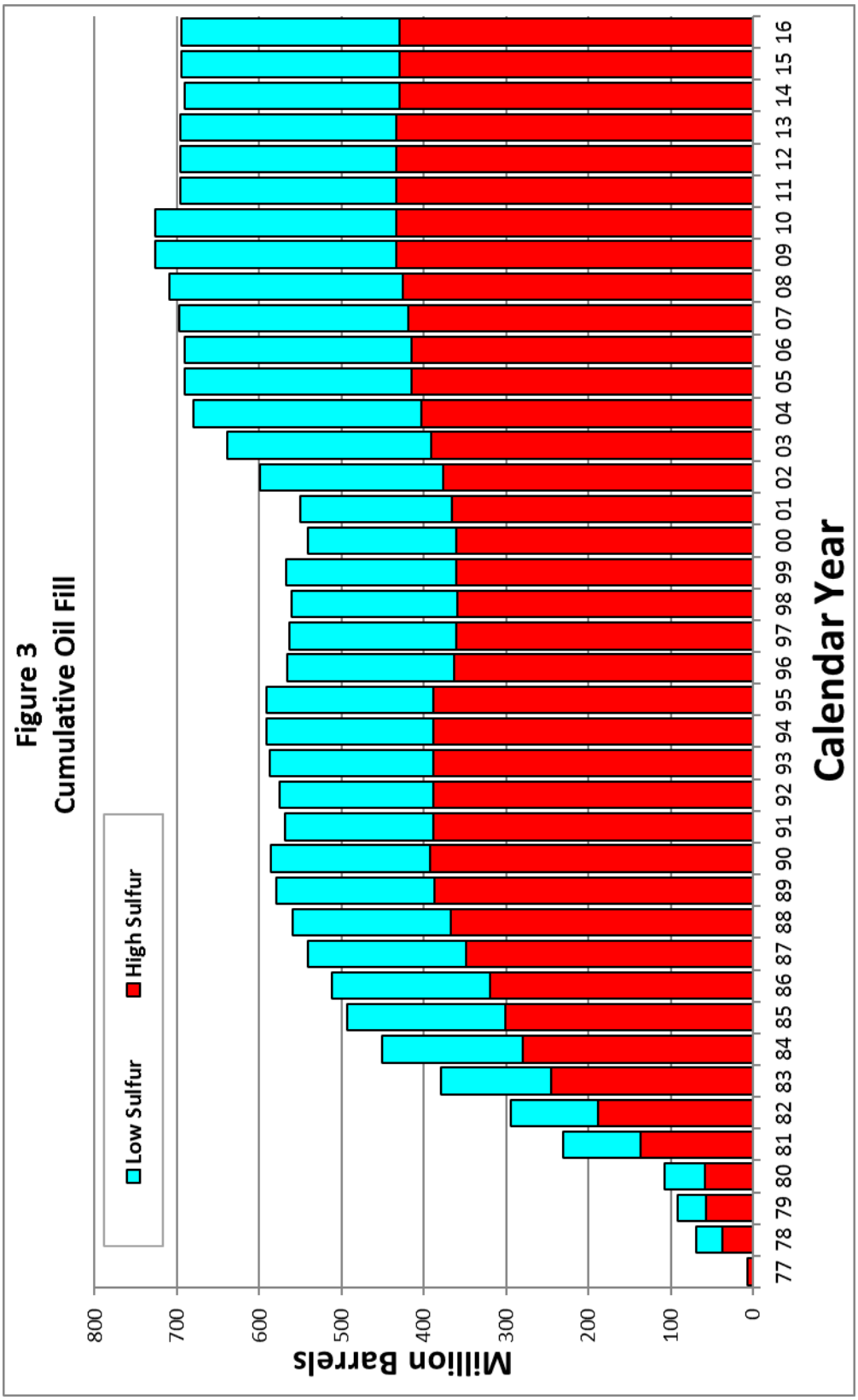


Figure 3 : Cumulative Oil Fill

IX. Emergency Response Capabilities

Sale of Oil

Section 161 of the EPCA gives authority to the President under specified conditions to direct the Secretary of Energy to conduct a public sale of oil from the SPR. Contracts are awarded to the highest qualified offerors.

Competitive Sales Procedures

DOE regulations in 10 CFR Part 625 govern the process for price-competitive sales from the SPR, including the establishment of Standard Sales Provisions that contain requirements for contracts used in the sale of the SPR crude oil. The first step in the process is the issuance of a Notice of Sale identifying the volume, characteristics, and location of the petroleum for sale. The Notice of Sale also provides delivery dates and the requirements for successfully submitting offers. Measures required for assuring performance and financial responsibilities are also described in the Notice of Sale.

During a drawdown, multiple Notices of Sale may be issued using a web-based automated oil sales and evaluation system, which provides a triple redundant backup system. Each Notice of Sale covers a sales period of one to two months. Offerors may have five days or less from the date a Notice of Sale is issued to submit offers. Delivery of oil could commence as soon as 13 days after the President calls for a drawdown of the SPR. Subsequent sale periods, if necessary, will correlate with standard industry delivery periods. Because of the possible short initial lead-time, DOE maintains a registry of prospective offerors who will receive electronic notification of all Notices of Sale.

The second step in the sales process is for prospective purchasers to submit offers, as specified in the Notice of Sale. Offerors must unconditionally accept all terms and conditions in the Notice of Sale and submit an offer guarantee of five percent of the maximum potential contract amount, or $10 million—whichever is less. The offer evaluation process is structured so that the offerors bidding the highest prices will determine the transportation methods, up to the limits of the distribution system. Specific delivery arrangements are negotiated later in the process.

Within five business days of being notified, all “apparently successful offerors” are required to provide a Letter of Credit equal to 100 percent of the contract amount as a guarantee of performance and payment of amounts due under the contract. Upon timely receipt of the financial guarantees and the Contracting Officer’s final determination that offers are responsive and selected offerors are responsible, Notices of Award are issued. Deliveries to the purchasers

may then begin, consistent with the purchasers' arrangements for commercial pipeline or marine vessel transportation.

Following delivery, the purchaser is invoiced for actual barrels received at a price that reflects the indexed contract award price, plus any adjustments for quality differentials, delivery mode, or location changes. Payment is due in the month following the delivery.

Drawdown Capabilities[3]

The crude oil acquired for the SPR is commingled in caverns at the storage sites, creating various distinct crude oil streams available for release. Table 5 identifies these crude oil streams, delivery modes, and locations.

Based on its design drawdown rate, the SPR can draw down crude oil at an initial sustainable rate of 4.415 MMbbl/D [4] for a period of 90 days. After this period, the drawdown rate gradually decreases as site inventories are depleted and the declining number of caverns containing crude oil becomes a constraint.

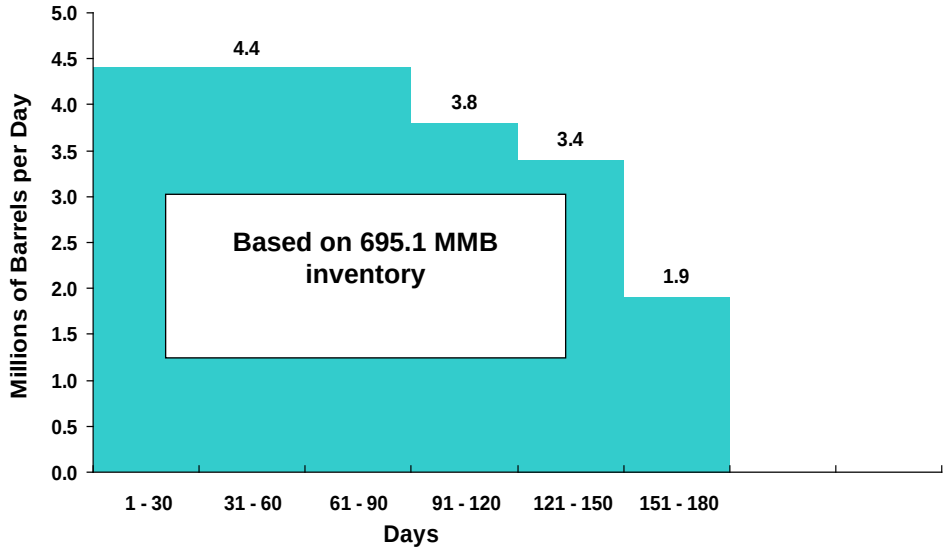
[3] This refers to the ability to displace oil out of the SPR caverns without considering whether the downstream distribution of the oil to SPR customers would accommodate that much oil being pumped out of the SPR caverns.
[4] Current design drawdown capability is reduced to 4.25 MMbbl/D due to unavailability of Bryan Mound Tank 2, pending repairs.

Table 5: Crude Oil Streams (As of December 31, 2016)

Crude Oil Stream	Gravity (°API)	Sulfur Content (Mass %)	Delivery Mode and Location
Seaway System			
Bryan Mound (Sweet)	36.4	0.38	Pipeline at Jones Creek Tank Farm, Jones Creek, Texas; Tankship at Seaway (Enterprise Products) Terminals in Freeport and Texas City, Texas; Genesis Terminal, Texas City, Texas
Bryan Mound (Sour)	33.3	1.41	
Texoma System			
West Hackberry (Sweet)	36.9	0.33	Pipeline, tankship or barge at Sun Partners Marketing & Terminals LP, Nederland, Texas; Pipeline at Zydeco-22"/DOE connection, Lake Charles, Louisiana
West Hackberry (Sour)	33.5	1.38	
Big Hill (Sweet)	35.4	0.40	Pipeline, tankship or barge at Sun Partners Marketing & Terminals LP, Nederland, Texas; Pipeline or tankship at Phillips 66 Terminal Nederland, Texas; Pipeline at Zydeco-20"/DOE connection, Winnie, Texas
Big Hill (Sour)	30.8	1.44	
Capline System			
Bayou Choctaw (Sweet)	35.4	0.43	Pipeline at Capline, Plains Marketing or LOCAP Terminals, St. James, Louisiana; Tankship at Sugarland St. James marine Terminal, St. James, Louisiana; 24-inch site connection to Red Stick Pipeline, Iberville Parish, Louisiana
Bayou Choctaw (Sour)	31.9	1.46	

Figure 4 illustrates the design drawdown capabilities during 2016, with an inventory of 695.1 million barrels.

Figure 4: Design Drawdown Capability (As of December 31, 2016)*



* Design drawdown capability is temporarily reduced to 4.25 MMbbl/D due to the unavailability of a storage tank at Bryan Mound that is used during drawdown.

Drawdown Readiness Activities

The SPR performed the following drawdown readiness assurance activities during CY 2016:

- The Drawdown Readiness Review program requires and monitors quarterly drawdown readiness. Four reviews were conducted in 2016, confirming that all sites and systems were prepared for a crude oil drawdown or exchange from the SPR.

- In support of Drawdown Readiness, Readiness and Capability and SPR Exchange Readiness and Capability reports are published quarterly, along with an update to Drawdown Configuration charts.

- The Systems Test Exercise (STE) program determines the drawdown readiness of a SPR site's equipment, procedures, systems, and personnel, and it collects data to further ensure a readiness status. The STE program involves a tabletop exercise at each site every year and a dynamic site test performed when directed. In 2016, tabletop exercises were conducted at all four storage sites.

- An administrative tabletop exercise was conducted at Big Hill on February 24. This exercise simulated a drawdown with the following two delivery groups: 1) 1.5 MMbbl of sour crude oil delivered to Shell Pipeline in 300 thousand barrel (Mbbl) batches at a rate of 240 thousand barrels per day (Mbbl/D) during 15 days, February 24–March 9; and 2) 3.0 MMbbl of sour crude oil delivered to Chevron Terminal in 500 Mbbl batches at a rate of 480 Mbbl/D during 15 days, March 10–25.

- An administrative tabletop exercise was conducted at Bryan Mound on August 24. This exercise simulated a drawdown with the following two delivery groups: 1) 5 MMbbl of sour crude oil delivered to Texas City in 500 Mbbl batches at a rate of 720 M during 15 days at Texas City, August 24 – September; and 2) 7.3 MMbbl of sour crude oil delivered to Freeport Docks in 500 Mbbl batches at a rate of 480 Mbbl/D during 15 days, September 8–22.

- An administrative tabletop exercise was conducted at Bayou Choctaw on April 19. This exercise simulated a drawdown with the following two delivery groups: 1) 1.5 MMbbl of sour crude oil delivered to Placid in 300 Mbbl batches at a rate of 192 Mbbl/D during 15 days, April 19–May 3; and 2) 3 MMbbl of sour crude oil delivered to St. James marine terminal in 500 Mbbl batches at a rate of 480 Mbbl/D during 15 days, May 4–18.

- An administrative Recovery Project Tabletop Exercise was conducted at the Stennis Space Center in Mississippi, on June 14 and West Hackberry on June 21. This exercise simulated a drawdown with the following delivery: 25.2 MMbbl of sweet crude oil delivered to Sun Terminal in a single batch at a rate of 840 Mbbl/D, during 30 days, June 21–July 20.

- Personal Readiness is Drawdown Excellence exercises are periodically conducted to examine specific processes within a drawdown with potential for improvement. PRIDE 11 incorporated lessons learned from Test Sale 14 to implement a digital signature capability for essential crude oil accountability documents. The second part of PRIDE, involving Financial Management and M&O finance personnel, examined the financial implications of a potential drawdown involving the distribution of Department of Defense-owned crude oil.

Distribution Capabilities

The substantial increase in both Canadian and U.S. domestic production has had a significant impact on both the magnitude and spatial disposition of crude oil supply over the past decade. Though several other regions of the country have emerged as significant supply centers, the Gulf Coast has turned into a major refining and trans-shipment destination for crude oil. As a result, there have been significant changes in the use of oil distribution infrastructure. Through 2011, most major pipelines originated in the Gulf Coast region and provided crude oil to local refineries and Midwest refiners. Since then, several major pipelines have reversed direction and are now flowing crude to the U.S. Gulf Coast refining centers, thereby reducing imports.

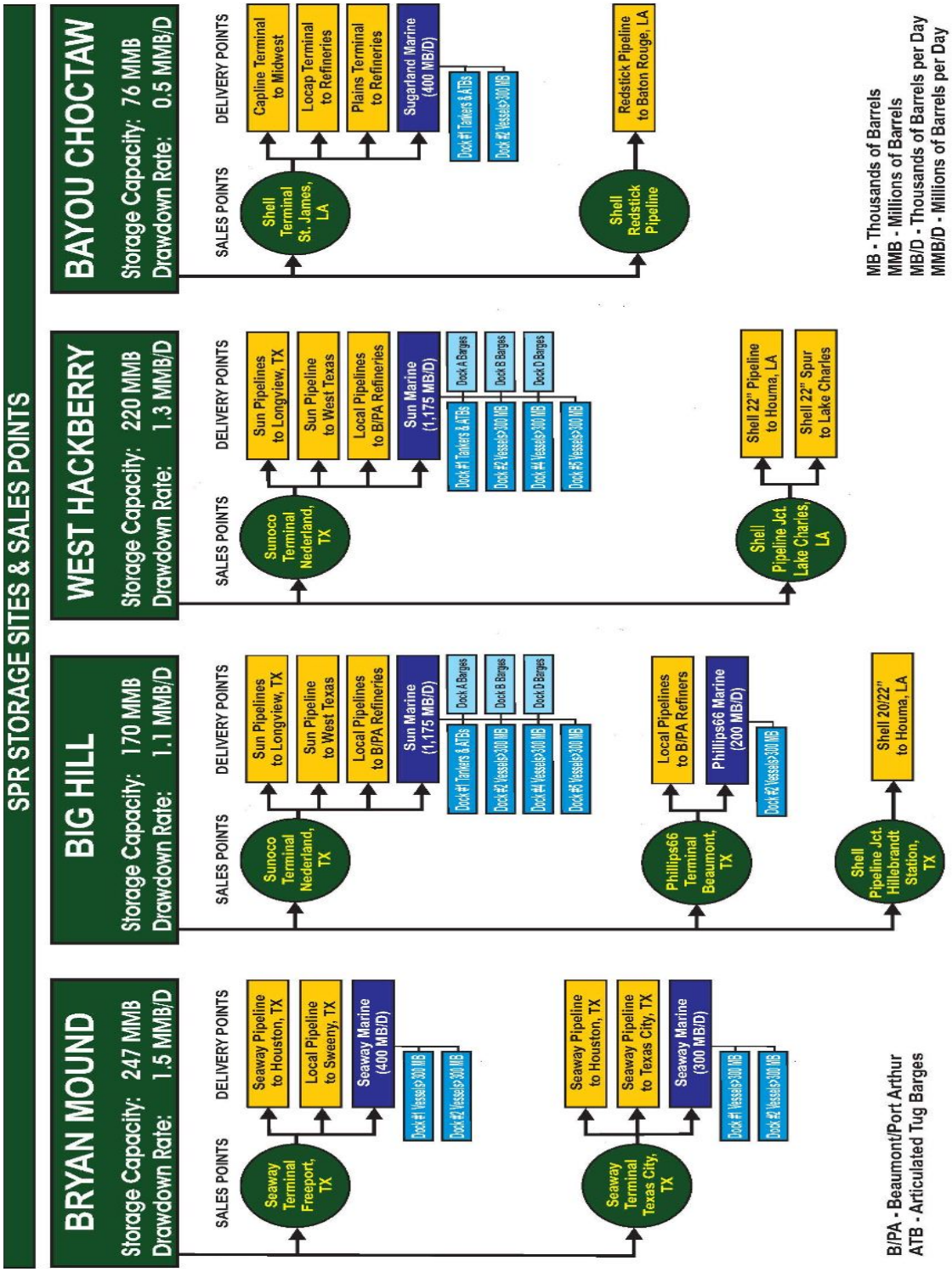
Consequently, in 2012, the SPR lost connectivity to 10 refineries in the Central United States when the Seaway Pipeline's flow direction was reversed. The Seaway Pipeline now flows from Cushing, Oklahoma, to Freeport, Texas. In December 2013, Shell reversed a section of the pipeline system, now referred to as the Houston-to-Houma system (formerly Houma-to-Houston and now known as the Zydeco Pipeline), to flow eastbound from Houston to the Louisiana Offshore Oil Port's terminal in Clovelly, Louisiana. As a result, the SPR's Big Hill site lost connectivity to Houston-area refineries, reducing the number of potential buyers that can receive SPR oil by pipeline. However, the flow of oil eastward now allows connectivity to refineries that were previously unable to receive pipeline deliveries from the SPR. Refineries along the Mississippi River, such as Valero Meraux, Shell Norco, and P66 Alliance can now receive pipeline deliveries from the SPR.

In 2016, the SPR was connected by commercial pipeline systems to about 57 percent of the refining capacity in the United States. That connection covers 45 refineries, which processed approximately 62 percent of crude oil imports to the United States during 2016. Remarkably, SPR connectivity to refineries has not changed much despite the reversal of the pipelines. Prior to the pipeline reversals in 2012, the SPR had connection to 49 refineries, which comprised 60 percent of refining capacity in the United States.

The SPR is also connected to four marine terminals that have a combined contracted marine distribution capacity of 2.075 MMbbl/D, and the SPR's St. James marine terminal, currently leased to Shell, has a distribution capacity of 0.400 MMbbl/D. These marine terminals are: Seaway Terminal (Enterprise Products), Freeport, Texas; Seaway Terminal (Enterprise Products), Texas City, Texas; Sunoco Terminal, Nederland, Texas; Phillips 66 Beaumont

Terminal, Nederland, Texas; and Shell Sugarland, St. James Marine Terminal, St. James, Louisiana. Figure 5 illustrates the SPR's pipeline and marine distribution capabilities.

Figure 5: Pipeline and Marine Design Distribution Capabilities



Distribution Assessment

The SPR performs an annual assessment—based on its established technical and performance criteria—that evaluates the SPR's crude oil distribution system capabilities to a) ensure that there are adequate connections to the commercial distribution systems and b) identify the need for any remedial plans. The 2016 distribution assessment evaluated the SPR's theoretical capability, at its maximum drawdown rate, to replace oil imported in the base year (2016) and, for future years 2020, 2025, 2030, and 2035. This report does not intend to model distribution capability during an actual emergency oil disruption event.

Established Level 1 Technical and Performance Criteria for the SPR's distribution capabilities require that the physical distribution system infrastructure—both DOE-owned and commercial—are capable of meeting distribution rates exceeding 120 percent of the combined site drawdown rates in order to provide sufficient allowances for terminal operational delays and commercial demand variances.

The distribution assessment and the results summarized below are based on a study of the physical distribution capacity. The physical distribution capacity is the total capacity of all physical connections from the SPR storage sites to commercial pipelines and marine terminals, including the DOE-owned St. James marine terminal. The capacity assumes that during a commercial supply disruption, the SPR is capable of utilizing 100 percent of its contractual terminal services to move oil from the DOE pipeline to vessels loading at the terminal's dock or to third-party pipelines or tankage via the contractor's existing connections. As stated previously, such an assumption is unlikely to reflect actual effective distribution capability during an emergency oil disruption event.

Base-Year Assessment

The base-year assessment indicates that two of the three SPR systems complied with Level 1 Performance Criteria (offsite pipeline and marine distribution capabilities exceed 120 percent of the combined maximum drawdown rates). The Level 1 Performance Criteria for the Texoma System remained below 120 percent for two years in a row as a result of petroleum infrastructure additions, pipeline reversals, and the subsequent marine terminal and pipeline congestions.

Table 6 provides the performance measures for the base and previous year.

Table 6: Base-Year Distribution Assessment

System	Design Max. Drawdown Rate (Mbbl/D)	Physical Distribution Capability (Mbbl/D)	Performance Measure as of 12/31/2015	Performance Measure as of 12/31/2014
Seaway	1,500	1,493	100%	118%
Texoma	2,400	2,292	95%	99%
Capline	515	829	161%	166%
Total	4,415	4,614	105%	113%

Mbbl/D = Thousands of Barrels per Day

Future-Year Assessments

From the 2016 perspective, for future years 2020, 2025, 2030, and 2035, the SPR performed an assessment using the U.S. petroleum refining supply and demand projections from the Energy Information Administration's *Annual Energy Outlook 2016 (AEO 2016)*. The future-year assessment assumes the design drawdown rate does not change from base-year levels and assumes no infrastructure changes to the SPR. Based on the *AEO 2016* projections for U.S. petroleum imports, the distribution assessment concluded that for the Seaway and Texoma systems, the distribution capability of the SPR falls below Level 1 Performance Criteria during the out years with the current infrastructure in place. In light of these results, remedial planning has commenced to address the insufficient connectivity to commercial distribution systems. Table 7 provides the performance measures by system for each forecast period.

Table 7: Base- and Future-Year Performance Measures

System	2020	2025	2030	2035
Seaway	98%	101%	85%	78%
Texoma	79%	80%	76%	76%
Capline	143%	166%	167%	170%

Physical vs. Effective Distribution Capability

The assessment discussed above focuses exclusively on the SPR's physical distribution capability, which is distinct from the *effective* distribution capability. The former focuses on the actual connections that the SPR maintains to physical assets, while the effective distribution capability is the rate at which SPR crude oil can be incrementally added to the market. Effective distribution capability depends on oil market activity, the utilization of commercial pipelines and commercial terminals at the time of drawdown, and the magnitude and geographical location of the oil supply disruption.

In reality, the ability of the SPR to distribute incremental oil without disrupting domestic and Canadian crude flows has diminished due to congestion of commercial facilities in the SPR's Gulf Coast distribution region. In recent years, the changing geography of U.S. oil production has led to major changes in the domestic oil refining and distribution systems. New patterns of oil supply and demand among U.S. oil producers and refineries, along with associated changes in the U.S. midstream, have significantly reduced the ability of the SPR to distribute *incremental* volumes of oil during possible future oil supply interruptions. Moving SPR oil to Midwest refineries—a historical pattern—would be of no value during a petroleum supply disruption as non-Canadian imports and Gulf Coast supplies have essentially disappeared in this refining complex. The U.S. pipeline distribution system, along with other modes of oil transport, is instead moving large volumes of oil to the Gulf Coast, especially from U.S. tight oil plays and Canada. This new geography of U.S. oil production and energy exports has also increased commercial traffic at U.S. Gulf Coast marine loading facilities.

While the SPR has throughput contracts for dock space use at five marine terminals within the SPR distribution system, use of these docks for the distribution of SPR crude oil will cause displacement of domestically produced oil and/or Canadian imported oil. The changing patterns of U.S. oil imports mean that the magnitude and geographic location of an international oil supply disruption can affect the capacity of the SPR to deliver oil to its customers. It can also affect the United States' ability to meet its International Energy Program obligations in the event of an International Energy Agency (IEA) collective action in response to a global supply disruption. If the SPR cannot load oil onto barges and tankers without disrupting commercial shipments, SPR sales could be offset by a corresponding decrease in domestic crude oil shipments or exports of domestically produced petroleum products. Because of the evolution of global oil markets, the participation of the United States in those markets, the changed geography and volume of U.S. oil supplies, a reduction in oil imports, and congestion of commercial facilities in the SPR's distribution region, an effective SPR release will increasingly depend on the ability to load *incremental* SPR oil onto marine vessels.

In 2016, the Office of Petroleum Reserves completed a scenario-based crude supply disruption analysis of SPR's effective distribution capability. The project quantified the SPR's distribution capabilities in terms of incremental barrels that can be added to the market without disrupting commercial flows. The analysis' results were included in the published report to Congress: *Long-Term Strategic Review of the U.S. Strategic Petroleum Reserve, August 2016*.

DOE's QER found that the SPR's ability to offset future energy supply shortages has been adversely impacted by domestic and global oil market developments, coupled with the need for upgrades. One of the QER's recommendations was to invest in optimizing the SPR's energy response capability, which included increasing the Reserve's incremental distribution capability by adding dedicated marine terminal capacity to the SPR distribution system.

International Energy Program Requirements

The United States, as a member of the IEA, is committed to maintaining stocks of crude oil and products in reserves that are equivalent to 90 days of net oil imports. Computations of member-nations' stockpile requirements are based on both publicly and privately held stocks, and net imports are defined as the average daily level in the previous year.

In the event of a severe petroleum supply interruption, the IEA Governing Board may choose to collectively release oil stocks to respond to the crisis. In a coordinated IEA response, each member country is responsible for a share of the total release that is proportionate to their share of total IEA oil consumption. For the United States, this share was 43.9 percent in 2016.

X. Commercial Activities

Commercial Leases

The SPR has commercialized its under-utilized crude oil distribution facilities to be more cost-effective, and it currently has leased three crude oil pipelines and a marine terminal to private industry. The contracts for these leases require that the facilities stay in good condition and, in the event of a Presidential call for an emergency drawdown, use of the leased facilities will be returned to the government in five days' notice. Receipts from the leases are deposited to the U.S. Treasury.

Bayou Choctaw Pipeline: In 2016, lease revenues for the Bayou Choctaw Pipeline totaled $360,500. This pipeline was leased to Shell Pipeline Company L.P. on May 1, 1997, on a revenue-sharing basis. In 1998, the lease was converted from an annual lease to a 10-year lease with automatic renewals in 5-year increments thereafter. The current lease period will expire on December 31, 2019.

Bryan Mound Pipelines: In 2016, lease revenues for the Bryan Mound Pipeline totaled $3,902,442. Two of the three Bryan Mound pipelines were leased to ExxonMobil Pipeline Company on January 14, 1999. ExxonMobil began using the pipelines in June 2000 as part of its onshore distribution system for the Diana-Hoover production in the Gulf of Mexico. The first 5-year option of the lease agreement was executed and began in June 2010. The second and final 5-year option of the lease agreement was executed on February 12, 2014, for the period of June 1, 2015–May 31, 2020.

St. James Marine Terminal: In 2016, St. James marine terminal lease revenues were $2,000,000. The terminal was leased to Shell Pipeline Corporation (now Equilon Enterprises LLC, "doing business as" Shell Oil Products US) on January 31, 1997, on a revenue-sharing basis. The contract was renegotiated for a period of two years in the amount of $2 million per year through December 31, 2019.

Foreign Oil Storage

The SPR promotes the concept of storing foreign oil in its unused storage space as a strategy to increase world oil stockpiling, to generate revenues for the U.S. Treasury, and/or to add oil to the SPR (in lieu of a fee). Section 168 of EPCA provides specific authority to store petroleum products of another country, or its representatives, in the SPR's facilities, provided that the United States is fully compensated for all related costs, and that the ability to draw down SPR oil is not impaired.

To enhance the SPR's offer to store oil for foreign governments or their representatives, the Big Hill storage site was activated as a special purpose Foreign Trade Zone subzone on September 28, 1998. This designation permits customers to store oil without paying customs fees and certain taxes. The Big Hill storage site is the only storage site to receive this designation.

Although the authority exists, the SPR has never stored foreign oil, and no commercial or foreign storage initiatives were considered in 2016 because there is limited spare storage capacity at the Big Hill site, and there were no proposals from foreign governments to do so.

Commercial Revenues

During calendar year 2016, receipts to the General Fund of the U.S. Treasury were $6,262,942 from the commercial leases of the SPR's distribution facilities and pipelines. Table 8 summarizes commercial revenues from 1996 to 2016.

Table 8: Summary of Commercial Revenues
(December 31, 2016)

Calendar Year	Bryan Mound Pipelines (Actual $)	Big Hill Pipeline (Actual $)	Bayou Choctaw Pipeline (Actual $)	St. James Marine Terminal Lease (Actual $)	Total Revenue Generated (Actual $)
1996	102,606	472,809	0	0	575,415
1997	0	429,824	0	133,300	563,124
1998	12,500	402,525	0	481,010	896,035
1999	679,393	400,000	163,030	546,125	1,788,548
2000	652,146	493,359	217,573	748,986	2,112,064
2001	1,054,297	33,104	212,738	1,227,021	2,527,160
2002	1,468,613	0	249,708	1,285,183	3,003,504
2003	1,647,828	0	168,718	1,863,060	3,679,606
2004	1,546,121	0	174,338	1,700,000	3,420,459
2005	1,132,668	0	730,542	1,700,000	3,563,210
2006	1,091,799	0	337,949	1,700,000	3,129,748
2007	1,128,340	0	218,912	1,700,000	3,047,252
2008	1,211,171	0	321,799	1,700,000	3,232,970
2009	1,141,228	0	232,374	1,700,000	3,073,602
2010	1,091,494	0	169,541	1,700,000	2,961,035
2011	2,124,218	0	318,183	1,700,000	4,142,401
2012	5,838,356	0	312,481	1,700,000	7,850,837
2013	17,270,421	0	274,481	1,975,000	19,519,902
2014	6,513,476	0	188,695	2,000,000	8,703,171
2015	11,243,574	0	236,583	2,000,000	13,480,157
2016	3,902,442	0	360,500	2,000,000	6,262,942

XI. Budget and Finance

With enactment of the Consolidated Appropriations Act, 2016 (Public Law 114-113), Congress appropriated $212 million for the SPR.

Appropriations through Fiscal Year 2016

A total amount of $24.4 billion, net of sales and transfers, has been appropriated for the SPR from FY 1976 through FY 2016. The distribution of this annual appropriation is described in Table 9.

Strategic Petroleum Reserve Account

The SPR Account funds the development, operation, and maintenance of facilities; the salaries and expenses necessary to plan and manage the program, including the operation of the SPR PMO in New Orleans, Louisiana; and the activities pertinent to major issues concerning the development and use of the SPR.

Obligations for the SPR in FY 2016 totaled approximately $212.1 million using new budget authority and prior year unobligated carryover. From this amount, $21.6 million was obligated for Federal program management. Another $190.5 million was obligated for contractual goods and services to operate and maintain the SPR and to conduct an emergency drawdown and sale, if required.

Table 9:
Appropriations for Storage Facilities Operations and Management and Petroleum Account*
(As of December 31, 2016)

Fiscal Year	Oil Account ($)	Facilities ($)	Management ($)	Expansion ($)	Total ($)	Defense SPR ($)
1976	0	300,000	13,975		313,975	
1977	440,000	0	7,824		447,824	
1978	2,703,469	463,933	14,704		3,182,106	
Total 1979 Appropriations*	2,356,456	632,504	18,111		3,007,071	
Total 1980 Appropriations*	(2,022,272)	0	22,272			
Total 1981 Appropriations*	3,205,094	108,168	19,391		3,332,653	
Total 1982 Appropriations*	3,679,700	175,656	20,076		3,875,432	
1983	2,074,060	222,528	19,590		2,316,178	
1984	650,000	142,357	16,413		808,770	
1985	2,049,550	441,300	17,890		2,508,740	
Total 1986*	(12,964)	106,979	13,518		107,533	
1987	0	134,021	13,412		147,433	
1988	438,744	151,886	12,276		602,906	
1989	242,000	160,021	13,400		415,421	
1990	371,916	179,530	12,953		564,399	
1991	566,318	187,728	12,846		766,892	
1992	88,413	171,678	13,384		273,475	
1993	(125,625)	161,940	14,227		50,542	
DOD Transfer (non add)	124,925	700	0		125,625	125,625
1994	0	191,035	15,775		206,810	
1995	(107,764)	226,938	16,780		135,954	
1996 transfer from SPR Petro	(187,000)	170,173	16,827		0	
1996 Weeks Island Oil Sale	(97,114)	97,114	0		0	
1996 deficit reduction oil sale	(227,000)	0	0		(227,000)	
1996 Total	(511,114)	267,287	16,827		(227,000)	
1997 Total*	(220,000)	193,000	16,000		(11,000)	
1998	0	191,500	16,000		207,500	
1999	0	145,120	14,805		159,925	
2000	0	144,000	15,000		159,000	
2001	0	140,672	15,965		156,637	
2002	0	154,009	16,871		170,880	
2003	1,955	157,823	13,909		173,687	
2004	0	155,044	15,904		170,948	
2005*	43,000	109,946	16,764		169,710	
2006*	(43,000)	190,510**	16,830		207,340	
2007	0	146,950	17,491		164,441	
2008		143,980	18,004	24,773	186,757	
2009	(21,586)	176,255***	18,824	31,507	226,586	
2010	0	199,732	19,091	25,000	243,823	
2011	0	186,873	22,568	0	209,441	
2012*	0	172,914	19,790	0	192,704	
2013*	0	162,975	19,650	0	182,625	
2014*	0	167,514	21,846		189,360	
2015		174,999	25,001		200,000	
2016	0	186,870	25,130		212,000	

Note: FY 1991 SPR Petroleum Account of $566,318 includes proceeds of $122,681 from the Test Sale recorded as additional budget authority, rather than reductions to obligations, costs, and outlays. It also includes $315,425 in Desert Storm Drawdown proceeds from January 1991, and $19,755, from FY 1991 Naval Petroleum Reserve excess receipts. Thus, the cumulative budget authority is "gross" and not related directly to the inventory of oil on hand. * Includes reprogramming, rescission, and transfer actions. ** Includes the return of $43,000,000 from the SPR Petroleum Account. *** Includes $21,586 from the SPR Petroleum Account for site maintenance activities.

Strategic Petroleum Reserve Petroleum Account

The SPR Petroleum Account funds the acquisition of oil for the SPR, the associated costs for transportation and terminal expenses, U.S. customs duties, Superfund and Oil Spill Liabilities Trust Fund taxes, and other miscellaneous costs.

During an emergency drawdown and sale, the SPR Petroleum Account is the source of funding for the incremental costs of withdrawing oil from the storage caverns and transporting it to the point where purchasers take title. Receipts from the sale of oil are deposited to the United States Treasury and an equal amount of mandatory budget authority is created in the SPR Petroleum Account.

On April 15, 2014, the Secretary of Energy authorized establishment of the Northeastern Regional Refined Petroleum Product Reserve, now identified as Northeast Gasoline Supply Reserve (NGSR), as a component of the SPR. The purpose of the NGSR is to mitigate market disruptions in the Mid-Atlantic and New England coastal areas caused by natural disasters. The Congressional Control level was established and $235.6 million was apportioned by the Office of Management and Budget, in late June 2014 from the 2014 SPR Test Sale receipts, to establish the NGSR. Oversight and administration of the product acquisition and commercial storage activities will occur for 4.5 years.

For FY 2016, the capitalized cost of the crude oil in the SPR was $20.8 billion, for an average cost per barrel of approximately $29.89 (excluding storage costs).

Through use of a Royalty-in-Kind (RIK) program, established by the United States Department of the Interior (DOI) from April 1999 through December 2009, the cumulative dollar value of the exchange barrels provided to the SPR, by contractors who received royalty oil from DOI, totaled $6.1 billion. The value of the RIK oil transferred from DOI to DOE through 2009—the last year of the program—is shown by FY in Table 10.

Table 10: Value of Royalty-in-Kind Transferred by the Department of the Interior

Fiscal Year	Royalty-in-Kind Transfer * Total Barrels (Source: DOE)	Reconciled Royalty-in-Kind Transfer Total Barrels* (Source: DOE)	Department of the Interior** Forgone Receipts – ($0) (Source: DOI)
1999	11,928,981	8,135,603	***
2000	15,105,558	18,898,937	560,521
2001	1,568,220	1,568,220	61,654
2002	10,575,379	10,575,378	262,752
2003	34,742,046	34,852,185	1,044,350
2004	35,506,135	35,599,310	1,191,284
2005	25,185,527	25,184,519	1,194,618
2006	0	0	0
2007	8,742,829	4,425,911	306,191
2008	15,943,421	15,943,421	1,600,027
2009	4,493,099	6,798,713	268,537
Total	163,791,195	161,982,197	6,489,934

* In coordination with the Minerals Management Service, DOE completed a total DOE-RIK program reconciliation (1999–2009) in CY 2009, requiring net figure adjustments to prior years.
** Net figures that include DOI preliminary volumes and adjustments to prior years.
*** Department of Interior data not available.

Performance Measurement

In FY 2016, the SPR tracked 19 measures that are indicative of how the strategic goals and objectives for the SPR were pursued. They are consistent with the SPR Plan, which provides a framework for implementing the program's mission by setting a course for the program and guiding decisions about the effective use of resources. Sixteen of the measures tracked met or exceeded the performance measure, while three measures did not meet the performance measure target during this period. Specifically, the measures that missed the target were:

- "Distribution Capability as a Percentage of Drawdown Rate" – Due to a reduction in locally connected refinery imports and interstate pipeline imports.
- "90 Day Sustainable Drawdown Rate" – The 12-month average fell below the target due to a September actual of 2.85 MMBD, primarily due to the transformer issue at Bryan Mound, which resulted in the site not being drawdown-ready for more than half of the month.
- "Well integrity Compliance with State Regulations" The Louisiana Department of Natural Resources was not notified of a failed MIT on West Hackberry-107 within the required time frame. The contractor made restitution and paid the required fine.

The financial measure of "Operating Cost per Barrel of Storage Capacity" was $0.246 versus a target of $0.30. This is a measure of operational cost-effectiveness and indicates the responsible use of financial resources. This measure is used to promote the efficient use of taxpayer resources provided to operate the SPR.

In FY 2016, the critical few performance measures were again incorporated into the SPR Annual Operating Plan, in accordance with the Under Secretary for Science's direction. This ensures integration of these critical few measures into the planning process and enables tracking of their performance. Table 11 reflects a complete accounting of the program's measures.

Table 11: Performance Measures

Performance Measures	FY 2015 Actual Performance	FY 2016 Target Output	FY 2016 Actual Performance
Oil Inventory, Drawdown Readiness and Distribution			
90-Day Sustainable Drawdown Rate	4.25 MMbbl/Day	4.22 MMbbl/Day	4.10 MMbbl/Day
Number of Days to Commence Crude Oil Drawdown	13 Days	13 Days	13 Days
Number of Days to Complete Heating Oil Drawdown	13 Days	13 Days per Drawdown	13 Days
Distribution Capability as a Percentage of Drawdown Rate	113%	≥120% of Drawdown Rate	104%
Calculated Site Availability	97.3%	≥95%	97.75%
Calculated Maintenance Performance Appraisal Report (MPAR) Rating	97.6%	≥95 out of a possible 100 points	98.1
Percent of Site Security Survey Ratings that are Satisfactory	100%	100%	100%
Number of Barrels of Crude Oil Degassed	45.6 MMbbl	35 MMbbl	44.0 MMbbl
Well Integrity Compliance with State Regulations	100%	100%	<100%
Customer Knowledge and Focus			
Percentage of Key Customers Visited	51%	N/A	N/A
Operational Effectiveness, Efficiency and Knowledge Management / Fiscal Responsibility and Budgetary Control			
Information System Availability	99.9%	≥97%	100%
Operating Cost per Barrel of Storage Capacity	$0.233	≤$0.30 per barrel	$0.246
NEHHOR Operating Cost – Negotiate best possible commercial storage rates per Federal Acquisition Regulations (FAR) system regulations	N$7.15 operating cost per barrel	N/A	N/A
NSGR Operating Cost – Negotiate best possible commercial storage rates per FAR regulations	$21.38 operating cost per barrel	N/A	N/A
Dynamic Teamwork: Continuous Improvement			
ISO 9001-2008 Certification	November 6, 2014	September 15, 2016	November 3 2015
Partnerships			
Number of Partnerships Arrangements with Federal, State, and Local Agencies	N/A	N/A	N/A
Memorandum of Understanding / Memorandum of Agreement with Federal, State, and Local Agencies to minimize life safety and environmental risks to the sites and community	13	13	13
Local Community Support / Environment, Safety, and Health			
Maintain or apply for OSHA VPP Star Status through completion of an annual self-evaluation or application for each SPR storage fixed site	February 15, 2015[1]	September 30, 2016	February 15, 2016[2]
Number of Cited Environmental Violations Received	0	0	0
Number of Reportable Releases to the Environment Annually		≤4	3
ISO 14001 Certification	February 15, 2015	Maintain SPR EMS certification with ISO 14001 by May 3, 2016	April 12, 2016
Site Sustainability Plan Submittal	November 24, 2014	November 25, 2015	November 25, 2015
Employee Development and Quality of Life			
Employee Individual Development Plans	100%	95%	99%

[1] February 15, 2015 is the application date for evaluation of performance in CY 2014

[2] February 15, 2016 is the application date for evaluation of performance in CY 2015

XII. Other Program Activities

Long-Term Strategic Review of the SPR

Section 402 of the Bipartisan Budget Act of 2015 (Public Law 114-74) required the Secretary to complete a LTSR of the SPR and submit a report of the review to Congress. In May 2016, the Office of Petroleum Reserves completed the review, which assessed the ability of the SPR to carry out its energy security mission in the context of changing North American and global oil markets. The LTSR addresses multiple challenges and critical decisions that impact the future of the Reserve, including changes in the U.S. midstream sector, which could constrain the SPR's normal distribution pathways; surface and sub-surface infrastructure challenges; questions regarding the appropriate inventory level for the Reserve; and the need to review the SPR's legal authorities within EPCA.

The LTSR contains an Executive Summary and nine chapters:

- **Chapter 1** – Provides a review of the SPR, including its history, role, legal framework, infrastructure, organizational structure, and release authorities, as well as an introduction to the Northeast Home Heating Oil Reserve and the NGSR.
- **Chapter 2** – Provides a detailed description and analysis of the SPR surface and sub-surface infrastructure, and the associated challenges related to the condition of physical assets and operational reliability.
- **Chapter 3** – Reviews the overall SPR distribution system, including the physical systems, capabilities, changes, and constraints within the system that impact the ability of the SPR to meet distribution requirements during global oil disruptions.
- **Chapter 4** – Discusses the costs and benefits of various SPR options and closes with a discussion of the geostrategic benefits of the SPR.
- **Chapter 5** – Reviews the SPR Modernization Program and the associated legislative authority, funding requirements, and impacts, including a discussion of both the SPR's LE2 and the Marine Terminal Distribution Capability Enhancements projects.
- **Chapter 6** – Introduces two major cost-benefit studies of the Regional Petroleum Product Reserves (RPPR), as recommended by the QER; outlines the parameters of potential RPPR configurations that were evaluated and the reasoning behind them.
- **Chapter 7** – Discusses the cost-benefit analysis of refined product storage in PADD V and the Southeast, as well as the methodology employed to evaluate both the costs and the economic benefits of each RPPR.

- **Chapter 8** – Provides an overview of the legal authorities that provide direction for the operation, maintenance, release, and distribution of SPR crude oil and also highlights ways in which EPCA could be amended to improve the efficient functioning of the SPR program.

- **Chapter 9** – Concludes with a summary of the results from the various studies and offers key findings.

Northeast Gasoline Supply Reserve

The NGSR consists of contracted storage at multiple facilities in the New York Harbor, greater Boston, Massachusetts, and greater Portland, Maine areas. The SPR does not own storage facilities suitable for the storage of refined petroleum products. It was determined that the benefits of contracting the storage of up to one million barrels (MMbbl) of refined petroleum products pursuant to the authority granted by section 171 of EPCA are comparable to the benefits from a similar action undertaken under Title I, Part B of the statute. It was also determined that the availability of funds in the SPR Petroleum Account would enable the creation of a refined petroleum product reserve in time for the 2014 hurricane season. Placing the refined product reserve within the normal supply chain also ensures product quality, because unlike crude oil, refined products require periodic turnover to ensure that the products remain within strict quality specifications.

Four storage service contracts were executed to support the establishment of a regional product reserve in the Northeast. The Northeast region of the United States heavily depends on product supplies from the Gulf Coast, as well as local refining and imports. The crude oil stored in the SPR sites along the Gulf Coast are well suited to mitigating impacts of crude oil supply to refineries. However, vulnerabilities elsewhere in the supply chain could still result in significant regional disruptions. The establishment of a regional product reserve closer to the point of consumption can mitigate the impact of short-term disruptions, while issues with the larger supply chain (from crude oil refining through product distribution to consumers) are resolved.

DOE provides operational oversight of the Reserve to include managing the contracts, providing for independent product quality and quantity assurance certifications, performing annual audits, establishing a sales procedure and platform, and coordinating with each of the storage contractors to ensure availability and accessibility of the government-owned product.

The storage contractors are responsible for maintaining both the quantity and quality of the refined product; this includes any seasonal changeover of products to comply with the U.S. Environmental Protection Agency's Clean Air Act requirements. Additionally, the contractors are obligated to ensure that their specific facility is available in the event that a release is required. This requirements includes the ability to meet the government's release requirements in the aftermath of an event without commercial electric power. In addition, the

contractors must provide detailed information on inventories, activities, and distribution capabilities at DOE's request if conditions exist for a potential release.

Quality and Performance Assurance

The SPR conducted oversight activities per DOE procedural requirements. These activities included on-site management appraisals, technical assessments, security surveys and quarterly reviews of the Management and Operating Contractor's Contractor Assurance System (CAS).

The CAS covers oversight areas mandated by DOE Order 226.1B, Implementation of DOE Oversight Policy. These categories are Environment, Safety, and Health (ES&H); Safeguards and Security; Cyber Security; and Emergency Management. Additionally, CAS has been expanded to cover Finance; Human Resources; Property and Facilities; Procurement; Cavern Integrity; Data Systems; Operations and Maintenance; Engineering; and Internal Audit.

The Quality and Performance Assurance Division (QPAD) conducted technical assessments on key areas within the M&O contractor's organization. The assessment of the Conduct of Operations program evaluated the M&O contractor's effectiveness in executing conduct of operations procedures at all of the SPR facilities. The assessment of the *Implementation of the West Hackberry Tank 14 Judgment of Needs Report* evaluated the M&O contractor's implementation of corrective actions to mitigate identified deficiencies associated with the use of a scissor lift at the SPR West Hackberry site. These assessments were conducted to evaluate contractor compliance with the oversight requirements in DOE Order 414.1D, Quality Assurance and DOE Order 226.1B, Implementation of DOE Oversight Policy.

QPAD personnel performed 22 inspections or site surveillances in FY 2016, which were documented in Technical Assurance Surveillance Reports. These included inspections at SPR sites and supplier/vendor facilities. These inspections ensured all activities and procedures were conducted according to contractual requirements.

QPAD personnel coordinated the oversight management process for the SPR. Six organizations including the Project Manager, General Counsel, Management and Administration, Maintenance and Operations, Systems and Projects, and Technical Assurance developed annual Oversight Management Plans for FY 2016. Each organization performed oversight activities in accordance with these plans. Oversight activities were reported quarterly, and QPAD personnel conducted an analysis and provided a roll-up status report to the Project Manager each quarter.

The oversight of the Critical Few Performance Measures included 10 objective processes. The assessment of each measure was conducted by a subject matter expert (SME) to ensure that the contractor's performance was measured against their objectives, appropriately monitored, documented, and verified. QPAD then performed an independent assessment to validate the SME's due diligence. Both positive and negative results were submitted to the Performance

Fee Board via the board secretary. Once the assessment results were completed and documented, a summary report was submitted to the Project Manager and the Performance Fee Board chairperson to determine the appropriate fee distribution.

Additionally, the SPR's Quality Council monitored the activities of five process improvement teams. The first team worked to identify methods to capture the unique knowledge and experiences of SPR personnel. The second team redesigned the methods by which performance evaluation tools are presented for use by SPR personnel. The third team was tasked to explore ways to enhance and improve DOE's on-site management appraisal process. The fourth team used results from a survey of PMO employees to identify the top challenges to achieving employee satisfaction. The SPR as a whole worked together to address those challenges. Finally, a fifth team worked to improve the SPR's onboarding process.

Executive Order 13693

The Office of the President issued Executive Order 13693, Planning for Federal Sustainability in the Next Decade, on March 19, 2015. The goal of Executive Order 13693 is to maintain Federal leadership in sustainability and greenhouse gas (GHG) emission reductions. The Executive Order incorporates and builds upon past Executive Orders and Memoranda, and has extended many current requirements to FY 2025. Executive Order 13693 revoked the following:

- Executive Order 13423 (January 24, 2007), Strengthening Federal Environmental, Energy, and Transportation Management.
- Executive Order 13514 (October 5, 2009), Federal Leadership in Environmental, Energy, and Economic Performance.
- Presidential Memorandum of December 2, 2011 (Implementation of Energy Savings Projects and Performance-Based Contracting for Energy Savings).
- Presidential Memorandum of May 24, 2011 (Federal Fleet Performance).

The goal of the Executive Order 13693 is for Executive departments and agencies to be among the Nation's leaders and "to build a clean energy economy that will sustain our prosperity and the health of our people and our environment for generations to come." Federal agencies must continue to increase efficiency and improve their environmental performance to help protect our planet for future generations, to avoid energy costs, and to make Federal facilities more resilient. The Federal environmental performance goals have been expanded and updated with clear objectives to reduce GHG emissions across Federal operations.

The SPR's efforts to achieve compliance with Executive Order 13693 include implementing activities, policies, procedures, and programs that support sustainability goals. The annual Site Sustainability Plan documents the status of these actions, as well as the SPR's successes and challenges in attaining these goals.

The Site Suitability Plan addresses the status of specific goals listed in the Executive Order which include:

- Reduce scope 1, 2, and 3 GHG emissions
- Utilize sustainable buildings—reduce energy intensity in goal subject buildings
- Promote renewable electric energy
- Reduce potable and industrial, landscaping, and agricultural water consumption
- Reduce fleet vehicle GHG emissions and fuel consumption
- Promote sustainable acquisition and procurement of bio-based products, energy- and water-efficient products, environmentally preferred products, non-ozone depleting chemicals, products with increased recycled content, and non-toxic and or less-toxic chemicals, and fuel-efficient products
- Practice pollution prevention and waste reduction by supporting ongoing waste recycling and reduction programs
- Initiate energy performance contracts
- Promote electronics stewardship by purchasing EPEAT-registered, ENERGY STAR® and Federal Energy Management Program-designated equipment, enabling power management, duplex printing, and other energy efficient and environmentally preferable features, and using environmentally sound disposal practices
- Incorporate climate change resilience by implementing policies, planning, procedures, and commitments to address the impacts of climate change.

Sustainability activities initiated and continued at the SPR in 2016 include:

- Tracking fugitive emissions
- Annually “right sizing” the vehicle fleet capacity by evaluating current fleet composition (e.g., vehicle size, number, and types)
- Employing alternative fuel (hybrid) vehicles; optimizing the number of vehicles in the agency fleet; supporting carpooling; and promoting telephone and video conferencing to reduce air and ground travel
- Encouraging teleconferencing to reduce travel by ground and air where practicable
- Installing a total of 29 standard electrical utility meters to allow the SPR to monitor energy usage of select buildings and 83 large (4,160 volts) pumps. Meter data is

captured on 15- or 30-minute demand periods and stored by a data historian for analyses

- Conducting internal energy and water surveys at one of the four storage sites annually; West Hackberry was surveyed in 2016
- When applicable, using raw water instead of potable water for firefighting activities, washing down pump pads, and for providing pump seal flush and bearing cooling; reporting all water leaks and repairing them as promptly as possible; and minimizing fire water flow during testing
- Installing more energy-efficient light-emitting diode (LED) bulbs, replacing fluorescent and high-pressure sodium bulbs, inside buildings
- Annually updating a building upgrade budget and schedule that addresses energy optimization; equipment life extension; GHG reduction and aging heating, ventilation & air conditioning and environmental control and air quality replacements
- Completing completed Phase 2 of the SPR Data Center server upgrades, resulting in more efficient and less space-consuming servers; Phase 3 is scheduled for 2017 if funding is available
- Purchasing renewable energy certificates as 100 percent new renewable wind credits
- Utilizing updated standard specifications, which incorporate sustainable materials and practices
- Continuing a “less-paper” work style promotional campaign, which first started in FY 2013, to reduce printing/copying
- Continuously improving programs for reducing waste generation; these programs diverted 99 percent of the hazardous waste was diverted in FY 2016
- Continuing efforts to minimize all wastes through source reduction and reuse; Reducing non-hazardous solid waste and construction and demolition (C&D) waste generation in FY 2016 (recycling 62 percent of municipal solid waste and 96 percent of C&D waste)
- Using the “Buy It Green” program for selecting environmentally preferable chemicals, products, and materials
- Utilizing the Qualified Products List as a management tool to review chemical products for environmental and industrial health impacts, permit the use of only low toxicity chemicals, and minimize waste generation
- Minimizing electronics’ energy consumption by employing virtual desk top function, thin clients, and power-saving and sleep modes

- Purchasing EPEAT and ENERGY STAR®-rated electronic equipment where appropriate in eligible product categories; 99 percent of eligible electronics purchased in FY 2016 were EPEAT-registered products;

- Disposing of excess electronics through reuse or recycling programs

- Continuing the implementation of the Natural Phenomena Hazards Assessment Program conducted in compliance with DOE O 420.1C, Facility Safety, Chapter IV (Natural Phenomena Hazards Mitigation) to address climate change.

Implementation of the Site Suitability Plan is supported by the SPR Energy Efficiency and Pollution Prevention Committee, comprising Federal and contractor personnel who review and propose projects that focus on energy efficiency and sustainability measures.

Vapor Pressure Mitigation

Reassembly and commissioning of the portable degasification plant (that had been stored at the Bryan Mound facility since 2011) was completed at the West Hackberry site in 2014. Operation of the West Hackberry degas plant started in August 2014 and continued through December 2016. The degas plant is scheduled to remain at West Hackberry until October 2018 and will degas 15 of the 21 West Hackberry caverns during that time. A process total of 42.7 MMbbl of crude oil was degassed in CY 2016.

The need for a continuous vapor pressure-mitigation program was recognized in 1992 through routine oil sampling of the caverns. Long-term storage of crude oil in salt caverns results in gradual geothermal heating that raises the temperature of the oil in some caverns from approximately 80 degrees Fahrenheit (°F) at the time of injection into the cavern to a range of 110°F– 130°F over time. In addition, because of operational activities that include occasional injection of raw water into the cavern, gasses encapsulated in the salt are released and absorbed into the oil while stored. Naturally occurring methane gas may also migrate into the cavern through the salt matrix through discontinuities. Under certain drawdown conditions, increased vapor pressure results in gas being released into the atmosphere in amounts that may pose ES&H risks.

The degas plant removes excess gasses from the crude oil so that it can be sold and distributed to customers with a greatly reduced potential for emission of volatile organic compound (VOCs) ozone precursors, benzene, and hydrogen sulfide. The plant reduces the amount of VOCs in the vapors from the treated oil by 97 percent. Specifically, given lifecycle VOC emissions from the plant averaging about two tons per year, emissions from a single, full-scale, end-of-life-cycle drawdown decrease by 77,000 tons—or 1,900 times the pollutants generated from operation of the plant over its entire 25 year life cycle.

International Organization for Standardization (ISO) 14001

In May 2000, the SPR became the first bulk petroleum storage organization, public or private, to receive an ISO 14001, Environmental Management System (EMS) certification. The SPR successfully maintained ISO 14001 certification by means of a third-party recertification audit. This certification is valid through April 2018 and was granted to all four SPR storage sites, and the New Orleans SPR PMO, including the warehouse building and the warehouse facility at the Stennis Space Center. In 2016, a surveillance audit was performed. The EMS began the transition to the new ISO 14001:2015 standard.

Environment, Safety, and Health

DOE is involved in EMS through the SPR Integrated Safety Management System (ISMS), of which the EMS serves as the environmental leg.

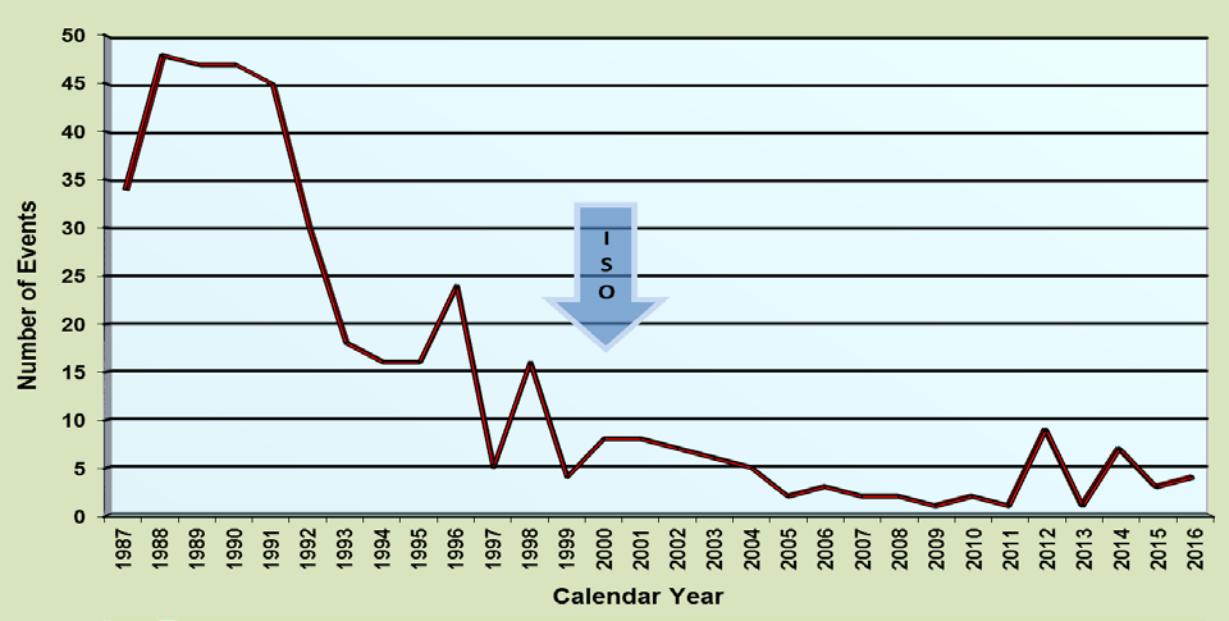
The SPR is accountable to the public for the safe delivery of crude oil during a national energy emergency and for being a good steward of the environment. During 2016, all SPR storage sites continued their participation in occupational safety and health programs, including OSHA's VPP and DOE's VPP. All four sites were recognized for their low accident rates by OSHA Region VI. Bayou Choctaw, Bryan Mound, and West Hackberry each received Star of Excellence awards, while Big Hill received a "Star Among Stars" Award. DOE also recognized all four sites, with Big Hill and Bryan Mound receiving Superior Stars, and Bayou Choctaw and West Hackberry receiving Stars of Excellence award.

The enterprise risk assessment was revised to evaluate the current risk to total SPR operation, taking into consideration existing hazard controls and quarterly reviews.

Figure 6 shows the SPR's performance for recordable environmental incidents from 1993 through 2016. During CY 2016, there were a total of four reportable project events at the SPR: three reportable releases to the environment and one permit exceedance. The CY 2016 reportable project events included:

- A 2 cup release of hydraulic oil into a navigable waterway (Black Lake) at West Hackberry
- A 2 gallon release of crude oil into a navigable waterway (wetland) at Bayou Choctaw
- A 4 bbl release of brine onto the ground at Bayou Choctaw
- A permit for non-compliance for exceeding the daily average of 20 milligram/liter for a Biochemical Oxygen Demand 5-Day Test at Bryan Mound. The release incidents were within the established targets of the FY 2016 work authorization directives.

Figure 6: Annual Summary of Project Events



Pollution Prevention

The SPR sets FY goals for hazardous solid waste, non-hazardous solid waste, and construction and demolition debris waste generated at our sites. Waste diversion is the prevention and reduction of generated waste. The SPR can achieve waste diversion in several ways, including source reduction, recycling, or reuse. These three waste streams were included based on the guidance in Executive Order 13693, "Planning for Federal Sustainability in the Next Decade."

In FY 2016, the SPR continued the strategy to reduce municipal solid waste sent to landfills, which in turn helps achieve DOE's GHG reduction targets.

Hazardous Waste

The SPR met the FY 2016 goal to divert at least 50 percent of hazardous solid waste generated with a diversion rate of 99 percent.

Non-Hazardous Waste

The SPR continued its successful efforts to reduce municipal solid waste by diverting 62 percent of non-hazardous solid waste during FY 2016. The goal was to divert at least 50 percent of non-hazardous solid waste.

Construction and Demolition Debris

The FY 2016 goal was to divert at least 50 percent of C&D debris waste generated. The SPR successfully met that goal by diverting 96 percent of C&D debris waste generated.

Exploration and Production

Although there are no specific goals established for Exploration and Production (E&P) waste generation or diversion, the SPR continued with its effort to recycle this waste stream whenever possible. During FY 2016, 94 percent of E&P waste was diverted. The generated E&P waste included crude oil-contaminated plastic and absorbents, crude oil-contaminated solids, workover wastes, off-specification crude oil mixtures, and drill-cutting wastes.

Environmental Improvement Measures

The SPR sites continued to maintain acreage for habitat enhancement for the benefit of both native wildlife and resident and migratory birds.

Throughout the year, educational papers and informative posters that highlight specific wildlife topics are developed and sent to the sites to be posted on their wildlife bulletin board. The sites perform periodic avian inventories which are uploaded into the Cornell Laboratory of Ornithology database.

The SPR recognized the 46th anniversary of Earth Day in 2016 as an opportunity for employees to join together and make commitments to environmental sustainability and a global green economy. Activities included employee participation in photo contests, Earth Day messages sent to employees, an Earth Day presentation made to an elementary school, and an Earth Day-themed cake served to employees.

Security and Emergency Operations

The SPR mitigated risk by ensuring the capability to effectively respond to any emergency during day-to-day operations and severe weather conditions. The Continuity of Operations Plan, Emergency Command Vehicle, communication vehicles, and the Emergency Communications Network are the cornerstones for continuing essential work functions under catastrophic conditions. Emergency response team members are assisted by protection force personnel as “support responders” for emergency conditions.

The SPR built the infrastructure for applying and maintaining a robust Homeland Security Presidential Directive 12-credentialing program that includes training and maintenance. In 2016, the SPR completed and executed its Strategic Plan to secure drawdown capability and protect people, resources, and classified information.

During 2016, the SPR completed four announced and four unannounced oil spill response drills in support of the Oil Pollution Act of 1990. Each storage site successfully executed two oil boom containment deployments and exercised command and control, as well as response and recovery activities.

The SPR strengthens its protection strategy by building relationships with the local communities' law enforcement and emergency response agencies. The SPR conduct exercises with these local agencies and personnel, and supports local community events.

Safety and Health Improvement Areas

Safety and Health Maintains Best Practice Performance

The SPR continued to improve the safety and health systems throughout the complex during 2016. The safe work permitting process was completely revised to improve ease of use, ensure proper workflow, and accurately identify hazard controls. Initiated by the M&O contractor in 2015, the Management in Action program was designed to create a dialog about safety between management and employees at the worker-task interface. In CY 2016, the Management in Action program expanded to include supervisors. The Safety and Health program also significantly strengthened their involvement in the subcontracting process. By being active participants in the process starting at procurement, Safety and Health can be proactive in ensuring adequate risk assessments are performed and hazard controls are implemented. Safety and Health's participation continues until contract closeout when lessons learned are documented.

An automated Job Hazard Analysis (JHA) process was also initiated after training at each of the sites. The new JHA uses drop prompts that aid users in identifying hazards and controls for a specific task. This automated JHA process has improved the quality and consistency of the JHAs. During CY 2016, the Industrial Hygiene (IH) program increased capacity by investing in equipment and dedicating funding to hire both temporary and permanent IH employees for conducting training and monitoring, as well as data management. They improved the procedure for work over rig monitoring. They also did a programmatic gap analysis to identify program areas for improvement and optimization, along with some additional training for Site Safety Specialists. DOE completed a Technical Assessment of the IH program that was published in September 2016.

DOE and Occupational Safety & Health Administration's Voluntary Protection Program

The SPR participates in the OSHA VPP and Process Safety Management programs, as well as in the DOE VPP. Each site must submit a candid self-evaluation to OSHA and DOE each year that includes 20 or more answers to very specific questions about their Process Safety Management system. The sites must also make ongoing improvements to their safety-management system.

Recommendations for improvements made during each of the OSHA on-site assessments must be replicated at all of the sites. In 2016, all four sites maintained their VPP certification, as did the security contractor at West Hackberry. The sites will have on-site OSHA assessments for continued acceptance in the VPP program beginning in July 2017.

Accident Rates for the SPR

During CY 2016, the SPR's Total Recordable Case Rate was 0.46 cases per 200,000 worker hours, which significantly improved upon the SPR's goal of less than 1.40 cases per 200,000 worker hours. The DART case rate was 0.00 per 200,000 worker hours—meaning that no work-related SPR injuries or illnesses were severe enough to require time away from work. A zero DART rate is well below the SPR's goal of less than 0.90 cases per hours. As a result, the SPR improved its safety record when compared to the one reported for CY 2015.

Integrated Safety Management

The SPR completed its annual ISMS validation and documented its performance in the *ISMS Annual Review and Update Report of 2016*, which summarized the results of all audits and assessments conducted during the FY. The report provides senior management with qualitative and quantitative data verifying that ISMS is performing effectively and as means of judging ISMS' annual performance. In 2016, additional leading indicators were added to the report from data compiled in the DOE Heroes for Zero program and from first-aid injuries. The annual report is briefed to the combined DOE and M&O contractor staff each year.

Annual Safety Summit and Tripartite Safety Council

The SPR held their Annual ES&H Summit in CY 2016. The ES&H Summit included briefings by the safety, health, and environmental departments of the M&O and the security contractor. Current issues were briefed and discussed in the open forum.

The SPR also conducted two Tripartite Safety Council meetings in CY 2016. The purpose of the meetings was to give all SPR contractors' representatives an opportunity to address safety issues directly with the SPR Project Manager that have not been resolved through normal channels. Each SPR site, the security contractor, and the architectural and engineering contractor had representatives at the meeting. Actions from the Council are tracked to closure.

In 2016, the M&O contractor again held an ES&H Week—an event that began in 2015. The SPR PMO and the four storage sites celebrated ES&H the first week of May. After a kick-off by senior management, which was televised from New Orleans, each of the sites conducted daily activities highlighting an environmental or safety topic; the activities had excellent employee participation. In New Orleans, there were lunchtime topics and other presentations.

Business Process Re-Engineering

The SPR information technology function is a national leader in the execution and implementation of re-engineering business processes, utilizing a combination of Microsoft SharePoint, InfoPath Forms, and K2 workflow engine. The SPR currently has developed and deployed over 50 automated business processes that ensure that tasks are completed timely and in a consistent manner. In 2016, system changes include consolidation of several systems into one large data-management SharePoint farm.

Data Security, Accessibility, and Resiliency

In 2016, the SPR has expanded the functionality of its Alternate Data Center, the program's emergency backup information technology system. The enhanced recovery capabilities allow for remotely accessible infrastructure with secure two-factor identification, a significant number of portable computers and smartphones, and robust backup communications to provide reliable performance for remote work in the event of an emergency. Comprehensive mobile device management for laptops, smartphones, and tablets is in place to improve user access to the Strategic Petroleum Reserve Office's data. Furthermore, a secure extranet is in place to significantly improve collaboration with partners and external customers.

Additionally, in 2016, efforts were underway in deploying wireless network infrastructure at the SPR storage sites to allow site users to participate in SPR automated business processes and have untethered access to SPR data. The SPR has implemented a strong cyber security program, used innovative approaches, and tailored controls and monitoring to the SPR operational environment. Per recommendation from the DOE Office of Enterprise Assessments review, a Privileged Account Management (PAM) solution was implemented in September 2016. The PAM solution improves security of privileged accounts on the SPRO network by requiring usage of multi-factor authentication via a Personal Identity Verification card. A cloud computing study was completed to determine how to best and cost-effectively use cloud services to improve accessibility and resiliency. The SPR uses Microsoft Office 365 to leverage cloud services for email and Microsoft Office capabilities. The main objective is to increase availability of email for the SPR mobile users.

Awards and Certifications

The SPR received the following awards for performance during 2016:

- OSHA Region VI Star of Excellence – Bayou Choctaw, Bryan Mound and West Hackberry
- OSHA Region VI Superior Star – Big Hill and Bryan Mound
- OSHA Region VI Star Among Stars – Big Hill

International Organization for Standardization 9001 Quality Management System

During 2016, Fluor Federal Petroleum Operations maintained their ISO 9001 and 14001 certifications.

Customer Service

The SPR's Customer Service Team met with several refiners, traders, pipeline companies, and other customers during the 2016 American Fuel and Petrochemical Manufacturers annual meeting in San Francisco, California, during the third week of March. Additional meetings were held at the SPR offices in Washington, D.C., and at some of the customers' corporate offices. Meetings with customers always have two primary functions: 1) to gather customer information as a way to improve the SPR's response capabilities and 2) to update those customers on SPR activities. The customers provided valuable feedback and reported that the overall experience was excellent.

In order to maintain an accurate and current list of customer contacts, each customer was asked to review their contact information and to provide updates on refinery activities such as expansion plans and any planned or actual changes to their crude oil inputs. Customers were also encouraged to discuss any operational or administrative issues they have encountered when dealing with the SPR so that the issues may be addressed.

The Customer Service Team provided updates to the customers regarding the status of the Reserve and welcomed questions from the customers. Customers provided the team with updates on refinery closings, shutdowns, and hurricane upgrades.

Real Estate Actions

During 2016:

- Amendment One to the Fully Reimbursable Space Act agreement between the National Aeronautics and Space Administration and DOE was fully executed on May 3, 2016, extending the lease agreement for Building 9355 located on the John C. Stennis Space Center through June 30, 2021.

- Facilities Information Management System validations for buildings, trailers, and other structures and facilities; DOE-owned land; DOE-archived assets and DOE leases were conducted with Fluor Property Section and Office of Asset Management in 2016. Fluor scored GREEN on all four validation scorecards.

XIII. Conclusion

The SPR continues to protect the U.S. economy from severe petroleum supply disruptions through continued operation and management of the U.S. emergency stockpile of crude oil. The SPR maintained crude oil stocks at four site facilities—Bryan Mound and Big Hill in Texas, and Bayou Choctaw and West Hackberry in Louisiana. The SPR entered 2016 with 695 MMbbl of crude oil, and as of December 31, 2016, the SPR held 695 million barrels, equivalent to approximately 145 days of net U.S. petroleum imports, which is a decrease of 37,475 barrels from 2015. The SPR also maintained 1 million barrels of refined petroleum product stocks in multiple contracted storage facilities in the New York Harbor, greater Boston, Massachusetts, and greater Portland, Maine areas; these stocks comprise the Northeast Gasoline Supply Reserve, a component of the SPR. The SPR ended 2016 with a 695 million barrel crude oil supply stock continued its efforts to maintain the SPR in accordance with EPCA (42 U.S.C. § 6201 *et seq.*).

XIV. Appendix: Strategic Petroleum Reserve Site Information

Bryan Mound

Location
Brazoria County, Texas (3 miles southwest of Freeport, Texas)

Site Description
247 MMbbl storage facility consisting of 19 caverns

24-inch diameter, 6-mile brine disposal pipeline extending 4 miles offshore in the Gulf of Mexico

Oil, brine, and raw water piping distribution system connecting caverns with central plant and water intake structure located on Brazos River; 21 pumps totaling approximately 45,000 horsepower

System Parameters

Drawdown Rate:	(Sour)	1,500,000 BBL/D*
	(Sweet)	1,000,000 BBL/D
Raw Water Pumping Rate:		1,626,000 BBL/D
Oil Fill Rate:		225,000 BBL/D
Brine Disposal Rate:		260,000 BBL/D

*Bryan Mound has three storage tanks that are required for site drawdown and refill operations. Two tanks are currently unusable due to a damaged internal floating pan. The unavailability of the storage tank has reduced the site's actual drawdown capability from 1.5 MMB/D to 1.35 MMB/D.

Distribution Facilities
DOE 3.9-mile, 30-inch pipeline to Seaway Freeport Marine Terminal; DOE 4.0-mile, 30-inch pipeline to Seaway Jones Creek Tank Farm and Pipeline; and DOE 46.3-mile, 40-inch pipeline to Seaway Texas City Terminal and Docks.

Acquisition
Acquired 499.47 acres fee simple, through eminent domain, April 1977, from Freeport Mineral Company and other owners. Dow Chemical Company was the previous operator.

West Hackberry

Location
Cameron Parish, Louisiana (25 miles southwest of Lake Charles, Louisiana)

Site Description
221 MMbbl storage facility consisting of 22 caverns.

Oil, brine, and raw water piping distribution system connecting caverns with central plant, water intake structure located on intra-coastal waterway and 9 brine disposal wells; 33 pumps totaling over 41,680 horsepower

System Parameters

Drawdown Rate:	(Sour)	1,300,000 BBL/D*
	(Sweet)	1,300,000 BBL/D
Raw Water Pumping Rate:		1,400,000 BBL/D
Oil Fill Rate:		225,000 BBL/D
Brine Disposal Rate:		225,000 BBL/D

*The drawdown rate is affected due to increased vapor pressure in several of the sites' caverns.

Distribution Facilities
DOE 42.8-mile, 42-inch pipeline to Sunoco Nederland Terminal; DOE 13.6-mile, 36-inch pipeline to Zydeco Pipeline common carrier pipeline system (Lake Charles Meter Station) at Carlyss

Acquisition
Acquired 405.36 acres' fee simple through eminent domain, April 1977, from numerous private landowners. Olin Corporation was the previous site operator. Acquired 160.0 additional acres fee simple by condemnation in two actions, July 1979 and March 1980.

Big Hill

Location
Jefferson County, Texas (26 miles southwest of Beaumont, Texas)

Site Description
170 MMbbl storage facility consisting of 14 caverns

Oil, brine, and raw water systems connecting caverns with central plant, water intake structure located on the Intracoastal Waterway, and a 48-inch diameter, 14-mile brine disposal pipeline extending 4 miles offshore in the Gulf of Mexico; 48 pumps totaling 46,000 horsepower

System Parameters

Drawdown Rate:	(Sour)	1,100,000 L/D
	(Sweet)	1,000,000 BBL/D
Raw Water Pumping Rate:		1,192,000BBL/D
Oil Fill Rate:		225,000 BBL/D
Brine Disposal Rate:		232,000 BBL/D

Distribution Facilities
DOE 24.5-mile, 36-inch pipeline to Sunoco Nederland Terminal; Phillips 66 2 mile, 24-inch pipeline to Phillips 66 Docks; Zydeco 20-inch pipeline system to Houma, Louisiana

Acquisition
Acquired 271 acres fee simple, through eminent domain, November 1982 and July 1983, from three landowners, i.e., 238.48 acres from Amoco, 27.06 acres from the Pipkin estate, and 5.46 acres from the Patrick Henry Phelan estate.

Bayou Choctaw

Location
Iberville Parish, Louisiana (12 miles southwest of Baton Rouge, Louisiana)

Site Description
76 MMbbl storage facility consisting of six caverns

Oil, brine, and raw water piping distribution system connecting caverns with central plant, a water intake structure, and 12 brine disposal wells). Eighteen (18) pumps totaling over 18,000 horsepower

System Parameters

Drawdown Rate:	(Sour)	515,000 BBL/D
	(Sweet)	300,000 BBL/D
Raw Water Pumping Rate:		558,000 BBL/D
Oil Fill Rate:		110,000 BBL/D
Brine Disposal Rate:		110,000 BBL/D

Distribution Facilities
DOE-owned 37.2 mile, 36-inch pipeline to Shell's Sugarland Terminal and Capline Pipeline.
Shell-owned 16 mile, 24-inch pipeline to Baton Rouge

Acquisition
Acquired 355.95 acres fee simple, through eminent domain, April 1977, from numerous private owners. Union Texas Petroleum (a subsidiary of Allied Corporation) was the previous operator.

In 1985, DOE acquired an additional existing cavern through a cavern exchange agreement with Union Texas Petroleum. The transaction involved a 3.5-acre exchange with no net change in government-owned acreage.

In November 2011, DOE acquired an existing cavern through eminent domain from Petrologistics Olefins, LLC to replace Cavern 20, which has experienced preferential leaching and is within 60 feet of the edge of the dome, posing an environmental risk with continued use.

List of Acronyms

AEO 2016	*Annual Energy Outlook 2016*
Bbl	Barrels
Bbl/D	Barrels per Day
C&D	Construction and Demolition
CAS	Contractor Assurance System
CY	Calendar Year
DART	Days Away/Restricted/Transferred
DOE	Department of Energy
DOI	Department of the Interior
E&P	Exploration and Production
EMS	Environmental Management System
EPCA	Energy Policy and Conservation Act
EPEAT	Electronic Product Environmental Assessment Tool
ES&H	Environment, Safety, and Health
˚F	Fahrenheit
FAR	Federal Acquisition Regulation
FY	Fiscal Year
GHG	Greenhouse Gases
IEA	International Energy Agency
IH	Industrial Hygiene
ISMS	Integrated Safety Management System
ISO	International Organization for Standardization
JHA	Job Hazard Analysis
LE2	Life Extension 2
LOCAP	Louisiana Capline
LTSR	Long-Term Strategic Review
M&O	Management and Operations
Mbbl	Thousand Barrels
Mbbl/D	Thousand Barrels per Day
MIT	Mechanical Integrity Test
MMbbl	Million Barrels
MMbbl/D	Million Barrels per Day
NGSR	Northeast Gasoline Supply Reserve
OSHA	Occupational Safety and Health Administration
PADD	Petroleum Administration for Defense District
PAM	Privileged Account Management
PSM	Process Safety Management
QER	Quadrennial Energy Review
QPAD	Quality and Performance Assurance Division
RIK	Royalty-in-Kind
RPPR	Regional Petroleum Product Reserves

SME	Subject Matter Expert
SPR	Strategic Petroleum Reserve
SPR PMO	Strategic Petroleum Reserve Project Management Office
SSP	Site Sustainability Plan
STE	Systems Test Exercise
VOC	Volatile Organic Compound
VPP	Voluntary Protection Program

List of Tables

List of Figures