

CRUDE-OIL STORAGE IN AN ERA OF PLENTY- Part 2:

“LESSONS FROM THE USA’s STRATEGIC PETROLEUM RESERVE”

**Oliver Nelson Gonsalves*

This is the second in an ongoing series of articles by the author on issues relevant to the strategic storage of crude oil. Part 1 had focussed the reader’s attention upon the prevailing state of India’s Strategic Petroleum Reserve (SPR). This one dwells upon the USA, which was, like India, one of the top importers of crude-oil and had consequently created the world’s largest SPR, before turning into a net exporter and is now reinventing the SPR concept as a whole. The two Parts, and those that will follow, form part of a major study being undertaken, at the National Maritime Foundation, on the maritime facets of India’s energy security.

USA’s Strategic Petroleum Reserve

Spread across the states of Texas and Louisiana, the Strategic Petroleum Reserve (SPR) of the USA consists of four sites, all close to the Gulf of Mexico, where crude oil is stored in 60 underground salt caverns (**Figure 1**).¹ These caverns range in capacity from 6 to 37 million barrels. A typical cavern holds 10 million barrels and is cylindrical in shape, with a diameter of 200 feet and a height of 2,500 feet.²

Figure 1: Strategic Petroleum Reserves of the USA



Map Source: US Department of Energy, Sandia National Laboratories, as cited in John Shages’s *The Strategic Petroleum Reserve: Policy Challenges in Managing the Nation’s Strategic Oil Stock*

¹ US Department of Energy, “SPR Storage Sites,” Strategic Petroleum Reserve, Office of Fossil Energy, US Department of Energy <https://www.energy.gov/fe/services/petroleum-reserves/strategic-petroleum-reserve/spr-storage-sites>

² *Ibid*

“Besides being the lowest cost way to store oil for long periods of time, the use of deep salt caverns is also one of the most environmentally secure. At depths ranging from 2,000 to 4,000 feet, the salt walls of the storage caverns are ‘self-healing’. The extreme geologic pressures make the salt walls rock hard, and should any cracks develop in the walls, they would be almost instantly closed. An added benefit of deep salt cavern storage is the subsurface temperature differential between the top of the cavern and the bottom, a distance of approximately 2,500 feet. The temperature differential keeps the crude oil continuously circulating in the caverns, maintaining the oil at a consistent quality. The fact that oil floats on water is the underlying mechanism used to move oil in and out of the SPR caverns. To withdraw crude oil, fresh water is pumped into the bottom of a cavern. The water displaces the crude oil to the surface. After the oil is removed from the SPR caverns, pipelines send it to various terminals and refineries around the nation.”³

The establishment of the USA’s SPR came about in the immediate aftermath of the decline of domestic oil production in the late 1970s, after its peak of 9.637 million barrels of oil per day (MMbbl/d) that had been registered at the very beginning of that decade. This decline in indigenous production was doubly worrying, since it coincided with the 1970s oil crises (the 1973 crisis was triggered by the Yom Kippur War, while the 1979 crisis resulted from the Iranian Revolution),⁴ as also with the intensifying of the domestic demand for crude oil and petroleum products in the mid-to-late 1970s (the demand was 18.43 MMbbl/d in 1977, peaked at 20.80 MMbbl/d in 2005 and was an estimated 20.46 MMbbl/d in 2019).⁵ *President Gerald Ford established the SPR when he signed the Energy Policy and Conservation Act into law. This was done in response to the oil embargo of 1973-1974 and the severe effect it had on the US economy. It mandates that the United States maintain a stockpile of one billion barrels of petroleum, which is the largest emergency supply in the world. The first import-shipment of oil, from Saudi Arabia, was delivered into the USA’s SPR on 21 July, 1977.*⁶

Although the US SPR was initially planned to accommodate one billion barrels of crude oil, limitations in physical design restricted the storage capacity of each SPR site to a maximum of 750 MMbbl, which was achieved in 1991 after the anticipated shortfall of supply from West Asia due to the First Gulf War.⁷ Based on consumption data, inventories in the SPR must consist a minimum stock of 350 MMbbl.⁸ The Department of Energy (DOE) manages the SPR of the United States. Consequently, the commodities held within the SPR are government-owned

³ *Ibid.* Strategic Petroleum Reserve: SPR Storage Sites

⁴ Time Magazine Archives, “Oil Squeeze: Ripples from Iran”, 05 Feb 1979, <https://web.archive.org/web/20080307085655/http://www.time.com/time/magazine/article/0%2C9171%2C946222%2C00.html>

⁵ US Energy Information Administration, Monthly Energy Review, Table 3.1, March 2020, preliminary data for 2019.

⁶ CNN Editorial Research, “Strategic Petroleum Reserve Fast Facts - Timeline” (updated on 30 January 2020). <https://edition.cnn.com/2013/09/02/us/strategic-petroleum-reserve-fast-facts/index.html>

⁷ Robert Pirog, “Strategic Petroleum Reserve: Mandated Sales and Reform,” Congressional Research Service, updated October, 1, 2020, <https://fas.org/sgp/crs/misc/R45577.pdf>

⁸ “Public Law 115-123 - Bipartisan Budget Act of 2018,” 115th Congress (2017-2018), Section 30204, <https://www.congress.gov/115/plaws/publ123/PLAW-115publ123.pdf>

stocks.⁹ Physical limitations notwithstanding, the stockpile held by the US is the world's largest. In December of 2009, the SPR sites, taken in aggregate, accommodated 726.6 MMbbl — the largest volume ever held.¹⁰ This build-up of the US SPR was probably a response to the 'Demand Shock' of 2008-09 — it would be recalled that in July of 2008, the international price of crude oil had hit an all-time high of US\$ 148 per barrel. Absorption of larger volumes also coincided with the requirement to *re-stock* an estimated 16.07 MMbbl of crude oil inventory that had been released to US refineries in the aftermath of the massive supply disruptions caused by Hurricane *Katrina* in 2005, and Hurricanes *Ike*, and *Gustav* in 2008.¹¹ In addition, the SPR received 8.7 MMbbl from the long-deferred Royalty-In-Kind (RIK) programme. This programme mandates that companies involved in Exploration and Production (E&P) activities in the USA's Outer Continental Shelf must pay the US federal government up to 16.7% in royalties in the form of crude oil.¹² Thus, through a combination of the repayment of supplies that had been loaned to US refineries — including 120,000 barrels in interest — after Hurricanes *Gustav* and *Ike*, direct purchases made from the revenue that had been earned from the sale of crude oil following Hurricane *Katrina*, and, the RIK oil, the inventory of the USA's SPR grew by a staggering 24.8 MMbbl in 2009 alone.¹³ The decision to stockpile such large volumes of crude oil, in excess of the USA's daily consumption in 2009, was vindicated just two years down the line — in June of 2011 — when, following the disruption of sweet crude supplies from Libya during the civil war there, the US federal government released 30 MMbbl of sweet crude oil from the SPR to US refiners.¹⁴ Once American refiners absorbed these inventories — released in conjunction with the International Energy Agency's (IEA) Emergency Response Drawdown — it reduced their demand for sweet crude, thereby preventing any surge of international sweet crude oil prices as had occurred in 2008-09.¹⁵

At present (April, 2020), the maximum available storage capacity of the USA's SPR is 713.5 million barrels.¹⁶ As of 17 April, 2020, the inventory held in the USA's SPR was 635 million barrels, which is the equivalent of more than 1069 days of net US oil imports (import protection). This means that if all supply of crude oil imports to the USA were to be totally disrupted, the country's SPR can supply crude oil to US refineries for an astounding 1069 days!¹⁷

⁹ US Department of Energy, "About the SPR", Strategic Petroleum Reserve, Office of Fossil Energy, <https://www.energy.gov/fe/services/petroleum-reserves/strategic-petroleum-reserve>

¹⁰ Pirog, "Strategic Petroleum Reserve: Mandated Sales and Reform," (Supra Note 7)

¹¹ US Department of Energy, "History of SPR Releases," Strategic Petroleum Reserve, Office of Fossil Energy, <https://www.energy.gov/fe/services/petroleum-reserves/strategic-petroleum-reserve/releasing-oil-spr#2005Katrina>

¹² US Department of Energy, "Filling the Strategic Petroleum Reserve," Strategic Petroleum Reserve, Office of Fossil Energy, US Department of Energy, <https://www.energy.gov/fe/services/petroleum-reserves/strategic-petroleum-reserve/filling-strategic-petroleum-reserve>

¹³ US Department of Energy, *Strategic Petroleum Reserve Annual Report for Calendar Year 2009*, Office of Petroleum Reserves, DOE/FE – 0538, <https://www.energy.gov/sites/prod/files/2015/02/f20/2009%20SPR%20Annual%20Report.pdf>

¹⁴ *Crude oil is broadly divided into sour (heavy) crude and sweet (light) crude based on their sulphur content. Sweet crude is easier to refine due to its low sulphur content and is thus more expensive than sour varieties.*

¹⁵ Clayton Blake, "Lessons Learned From the 2011 Strategic Petroleum Reserve Release," Council on Foreign Relations, Working Paper, September 10, 2012, 3-5, <https://www.cfr.org/report/lessons-learned-2011-strategic-petroleum-reserve-release>

¹⁶ US Department of Energy (DOE), "SPR Quick Facts" <https://www.energy.gov/fe/services/petroleum-reserves/strategic-petroleum-reserve>.

¹⁷ *Ibid.* <https://www.energy.gov/fe/strategic-petroleum-reserve>

The USA's inventory of the SPR far exceeds the 90-day minimum stipulated requirement for import protection based on the previous year's consumption as laid down by the IEA.¹⁸

How did the USA land up in this situation? Even more importantly, how might it seek to get out of it and how might its choices impact the very concept of an SPR?

In 1975, at the time of the creation of the first SPR site, the US was importing 4.099 million barrels of crude oil per day (MMbbl/d). (By way of comparison, this is only slightly less than the 4.55 MMbbl/d that India currently imports).¹⁹ By 1977, US imports had climbed to 6.56 MMbbl/d. They peaked, in 2005, at 10.09 MMbbl/d (which amounted to almost 48.50% of the total US crude-oil demand. This, in turn, corresponded with the USA's lowest ever level of indigenous production of crude oil, which, in 2005, was 3.81 MMbbl).²⁰ The USA's indigenous production of crude oil remained a dismal one and even in 2008, when the 'demand shock' hit, indigenous production was still a paltry 3.84 MMbbl/d.²¹ Fortuitously, however, this was precisely when the science underpinning the extraction of shale oil (and shale gas) was established as being a commercially viable process. This launched the 'shale revolution' as it was called, and US indigenous production of crude-oil sky-rocketed.²² In just a decade, the US reversed its high import dependence by expanding the domestic production of crude oil. In February of 2020, the country produced an all-time high of 13 MMbbl/d.²³ and now meets 94% of its total daily consumption needs.²⁴

Escalating domestic oil production and decreasing domestic demand for imported petroleum-products have bolstered the country's position as a net oil exporter since 2010.²⁵ This newfound role of being a net exporter of crude oil has led to major criticism — comprising appeals for extensive contraction of capacity and even complete closure — of the vast and expensive SPR programme.²⁶ The expense factor cannot be underplayed. In 2017 alone, the annual maintenance costs of the USA's SPR — the world's largest artificial reserve of crude oil — totalled US\$ 220.8 million.²⁷

¹⁸ International Energy Agency (IEA), "Oil security: The Global Oil Market Remains Vulnerable to a Wide Range of Risk Factors", <https://www.iea.org/areas-of-work/ensuring-energy-security/oil-security>

¹⁹ Government of India, Ministry of Petroleum & Natural Gas, Petroleum Planning & Analysis Cell, "Import/Export", https://www.ppac.gov.in/content/212_1_ImportExport.aspx

²⁰ Macrotrends website, "U.S. Crude Oil Production - Historical Chart", <https://www.macrotrends.net/2562/us-crude-oil-production-historical-chart>

²¹ Macrotrends *Ibid*

²² US Energy Information Administration, *Monthly Energy Review*, Table 3.1, March 2020, preliminary data for 2019.

²³ Macrotrends website (Supra Note 15)

²⁴ US Energy Information Administration, *Monthly Energy Review*, Tables 3.3b and 3.3e, April 2020, preliminary data for 2019 <https://www.eia.gov/energyexplained/oil-and-petroleum-products/imports-and-exports.php>

²⁵ Carlos Pascual, "The New Geopolitics of Energy," Center on Global Energy Policy, School of International and Public Affairs, Columbia University (September 2015), https://relooney.com/NS3040/000_New_2395.pdf

²⁶ Steve Hanke, "Trump: Transform the U.S. Strategic Petroleum Reserve into An Oil Bank," *Forbes*, 27 September 2019. <https://www.forbes.com/sites/stevehanke/2019/09/27/trump-transform-the-us-strategic-petroleum-reserve-into-an-oil-bank/#4602dbc93279>

²⁷ "Strategic Petroleum Reserve Annual Report for Calendar Year 2017," Report to the US Congress, US Department of Energy, December 2018, 28, <https://www.energy.gov/sites/prod/files/2019/02/f59/EXEC-2018-001277%20-%202017%20SPR%20Report.pdf>

Seeking a way out, successive US administrations have been trying to transform the conceptual rationale underpinning the creation of the SPR. It was no longer to be a cushion designed to protect the USA by allowing it to continue to meet its domestic demand by dipping into a 'reserve' even when faced with supply-disruptions resulting from external geopolitical instability. Instead, it was to now be merely a gigantic storage facility that could meet the demand of US refineries at an appropriate cost. In other words, it would now be a 'revenue earner' for the US Treasury. It would, additionally, be able to compensate for disruptions to the production and supply of domestically-produced crude-oil, as a result of natural disasters.²⁸

Accordingly, the federal government negotiated the reduction of SPR inventories, so as to earn revenue for the US Treasury and to simultaneously pay for the cost of modernising a smaller but more technologically robust SPR.²⁹ The technical modernisation of the SPR sites was necessary because, as things currently stood, minor but frequent withdrawals of SPR stocks tended to cause geological and structural damage to the storage caverns.³⁰ Since 2017, the regulated sale, in the open market, of crude oil from SPR sites, has increased the generation of revenue for a string of initiatives in healthcare, roadways, water resources development, etc.³¹ The federal government intends to *sell* over 250 MMbbl of crude oil from its SPR inventories by 2028.³²

As of 2019, the US government has earned more than US\$ 1.5 billion in revenues from the sale of SPR crude oil.³³ Further, the monetisation of surplus storage capacity by leasing it, on commercial terms, to American oil producers and foreign governments is expected to bring in additional revenue for the federal government.³⁴

In March 2020, Australia was negotiating a ten-year lease of storage capacity – worth US \$59 million – from the US SPR as the former's commercial storage, comprising surface tanks, were already filled to their maximum capacity.³⁵

The current global economic collapse, engendered by the COVID-19 pandemic, has very serious implications for US shale-oil manufacturers. The average breakeven price for shale-oil drilling and production is between US\$ 45 to US\$ 50 a barrel.³⁶ *"Just five shale drillers—Exxon, Chevron, Occidental, and Crownquest—can drill new wells at a profit at \$31 per barrel of West Texas Intermediate."*³⁷ It is for this precise reason that President Trump attempted to make a U-turn on the whole SPR

²⁸ Robert Pirog, "Strategic Petroleum Reserve," 1.

²⁹ "History of SPR Releases," Strategic Petroleum Reserve, Office of Fossil Energy, US Department of Energy, accessed May 06, 2020 <https://www.energy.gov/fe/services/petroleum-reserves/strategic-petroleum-reserve/releasing-oil-spr#FY-2017-Mandated-Sales>

³⁰ John Shages, "The Strategic Petroleum Reserve," 6. Storage in salt domes was designed only for five drawdown (removal) cycles

³¹ Robert Pirog, "Strategic Petroleum Reserve," 1.

³² Robert Pirog, "Strategic Petroleum Reserve," 4.

³³ Robert Pirog, "Strategic Petroleum Reserve," 5.

³⁴ "H.R.6511 - Strategic Petroleum Reserve Reform Act," 115th Congress (2017-2018), Sec. 2, accessed April 26, 2020, <https://www.congress.gov/bill/115th-congress/house-bill/6511>

³⁵ Sonali Paul, "Australia to Spend \$60 Million Buying Oil to Store in U.S. reserve," Reuters, <https://www.reuters.com/article/us-australia-oil/australia-to-spend-60-million-buying-oil-to-store-in-us-reserve-idUSKCN2240AA>

³⁶ "The Lowest Shale Breakeven Costs Are Here", Oil & Gas 360, Oilprice.com website, <https://oilprice.com/Energy/Crude-Oil/The-Lowest-Shale-Breakeven-Costs-Are-Here.html>

³⁷ Irina Slav, "Only 5 Shale Drillers are still Profitable at \$31 Oil", Oilprice.com website, 10 March 2020 <https://oilprice.com/Latest-Energy-News/World-News/Only-5-Shale-Drillers-Are-Still-Profitable-At-31-Oil.html>

reassessment by trying to purchase an estimated 77 MMbbl for the SPR — a bid to increase global crude oil prices by creating an artificial demand. The idea was to assist small American shale oil producers affected by plummeting crude oil prices. However, the administration failed to acquire the requisite funding from the US Congress, which, in turn, felt that any federal assistance would resemble a populist Band-Aid solution to a failing industry, unable to compete with cheap oil from foreign sources.³⁸

After the US Congress rejected the Trump administration's proposal for direct purchases in March 2020, the President floated the idea of leasing storage capacity (for up to 30 MMbbl) to American shale oil producers. However, the lukewarm response to the government's new proposal suggests the industry's concern on who will foot the bill for transport.

So, what does all this say about the future of SPRs? It seems obvious that once a country's dependence upon the import of crude-oil becomes negligible, the rationale for the creation of an SPR no longer holds. But what of SPR facilities that were already created when the need was great, but the need then diminishes to nearly zero? How much SPR should a nation create if it hopes, in the near future, to achieve a sharply-reduced import-dependence upon crude-oil? What lesson should Indian policy-makers draw in this regard? As has been shown, maintaining an SPR is an expensive business. The larger the SPR capacity and the more geographically-dispersed the sites are, the costlier is the maintenance. If India is seriously hoping for near-term success in substituting crude-oil with natural gas, or with renewables, then should the government not adopt a 'minimalist' approach to SPR? If the US example is anything to go by, the difference in scale notwithstanding, the answer appears to be a 'Yes'.

Are there different SPR-lessons to be learnt from China? Or Pakistan? The next part of this analysis will seek to address these and allied issues.

**Oliver Nelson Gonsalves is an Associate Fellow at the National Maritime Foundation. He can be contacted at associatefellow1.nmf@gmail.com*

³⁸ Devika Krishna Kumar, "Drowning in Crude, US Drillers say Trump Strategic Reserve Plan is No Lifeline," *Forbes*, April 23, 2020 <https://in.reuters.com/article/global-oil-usa-reserves/drowning-in-crude-u-s-drillers-say-trump-strategic-reserve-plan-is-no-lifeline-idINKCN2251X9>