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UNDERGROUND SALT CAVERN STORAGES FOR CRUDE OIL AT BIKANER, INDIA

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Abstract

Creation of strategic petroleum reserves (SPR) is one of the several contingency measures being adopted by oil consuming economies to meet the energy security mandate. Underground salt cavern storages being one of the suitable alternatives, a feasibility study was undertaken for locating a SPR near Bikaner, Rajasthan, India. As part of the studies, representative investigations followed by laboratory tests and studies were carried out for establishing suitability of the site in terms of geological setting, rock-mechanical properties and availability of ground water for undertaking solution mining.

Characterized by an extensive tract of bedded salt formation in the arid north western region of India, a study reveals that the Nagaur Ganganagar evaporite basin was developed as a shallow foreland basin during the late Phanerozoic and early Palaeozoic period. The basin fill consists of the clastic Jodhpur Group in the lower part, the Bilara and Hanseran Groups of mainly carbonates and evaporites in the middle part, and the Nagaur Group, again predominantly clastic, in the upper part. The formations are overlain by Tertiary and Quaternary sediments and by a thick cover of recent Aeolian sands of the Great Thar Desert.

With seven layers of identified bedded salt formations with sequence numbers from bottom to top, the sixth halite (H6) layer with a maximum thickness of about 220m and very limited anahydrite partings indicates feasibility to create underground salt caverns for storage of crude oil. With a depth range of 500m to 750m, the H6 salt layers is overlain by a shallow saline aquifer at a depth of 200m, which has been identified as the possible source of water for solution mining. For the purpose of brine disposal, the arid desert terrain offers suitable setting for locating solar evaporation basins.

With the availability of a favorable geological setting, i.e. a bedded salt formation of appropriate depth and thickness, and of a shallow aquifer to provide sufficient yield of (slightly saline) groundwater, underground salt caverns is the selected storage alternative for the Bikaner area with an envisaged storage capacity of 3.75 MM t (or 4.4 to 4.0 MM m³) of crude oil planned to be stored in eight caverns. Based on the investigations and test results the caverns have been designed for an optimum dimension of tear shaped caverns with 150m of height and 110m diameter at the bottom with storage capacity of 550,000 m^3 each and cavern spacing of 300m.

The present paper outlines the geological setting and geo-mechanical properties of the bedded salt formations and corresponding feasibility to create underground salt cavern storages in India.

Key words: Salt Caverns, Crude Oil, Geological Setting, Bikaner