

Chapter 2 Crude Oil Production Measurement and Reporting System

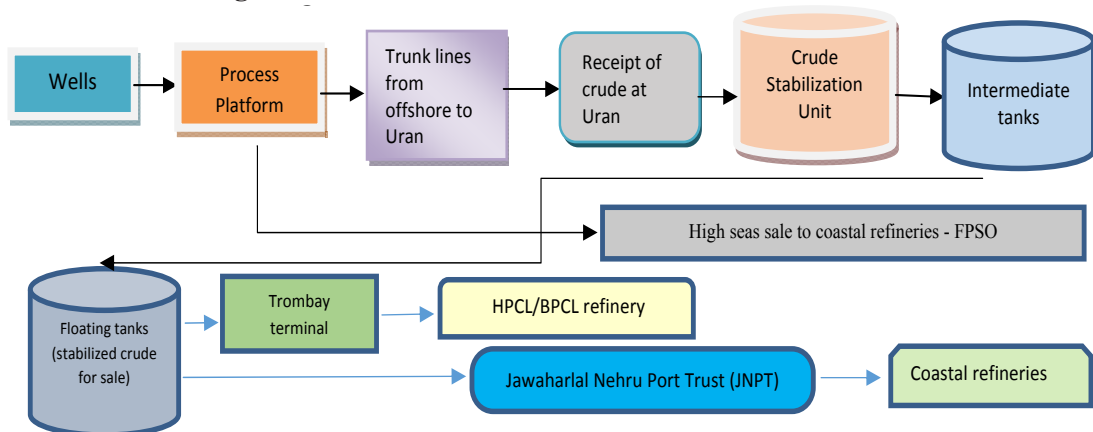
2.1. Offshore Assets

2.1.1 Production of crude oil in Mumbai offshore Assets

The Mumbai offshore field comprising of Mumbai High, Neelam Heera and Bassien & Satellite Assets is the Company’s largest producer of crude oil. In contrast, Eastern offshore Asset is a minor contributor, accounting for 0.11 *per cent* of the offshore crude production.

The production facilities in Mumbai offshore field include well head platforms, process platforms, onshore terminal and pipelines linking them. The well fluids from the offshore well head platforms are transported to the process platforms through subsea well fluid lines. At the process platform, the well fluids are separated into crude oil, gas and water. The separated, partially stabilized, crude oil is then pumped through the trunk lines to the onshore terminal (Uran) for further processing/stabilization before selling to the consumers. Processing facilities at Uran include Crude Stabilization Unit (CSU), where water is drained out and off-gas² is removed and added to gas stream. The stabilized crude from CSU is stored in intermediate tanks for further stabilization and then transferred to crude oil floating tanks. The crude oil from the floating tanks is dispatched to Trombay terminal and Jawaharlal Nehru Port Trust (JNPT) for sale to downstream refineries. Crude from isolated fields is produced through Floating Production Storage and Offloading vessel (FPSO) and transported through marine tankers to coastal refineries (around 7.90 *per cent* of total offshore crude oil production). The schematic diagram for production of offshore crude oil is depicted below:

Figure-2: Production of crude oil at Mumbai offshore



² Off gas is dissolved gas in partially stabilized crude oil dispatched from offshore to Uran. It is removed in Uran plant during processing and stabilization of crude oil and added to gas production.

2.1.2. Measurement of crude oil at Mumbai offshore

Measurement of crude oil produced at Mumbai offshore is carried out at the offshore process platform, the Uran plant and the custody transfer point - point of sales to refinery, e.g., Trombay terminal and JNPT. The process for measurement and the documents maintained at each of these locations are detailed below:

- **Process platforms:** The partially stabilised crude oil dispatched to Uran plant is measured using Turbine Meters³ (TM) at the outlet of the process platforms. This is the 'wet crude'. The water content in the crude is separately measured using Auto Samplers⁴. The 'wet crude' is adjusted for the water content, so measured, to arrive at the 'dry crude' dispatched from the offshore process platform which is reported as the crude oil production from Mumbai offshore fields.

The process platforms maintain the Daily production report (DPR) of crude oil dispatched in Microsoft Excel sheets. These documents (Excel sheets indicating DPR) are prepared manually by recording the production data displayed on the Human Machine Interface (HMI)⁵ of the Turbine Meters on a real time basis. The laboratory report on the water content in the crude oil and its density is also separately maintained. No physical or electronic back-up of the production data is however taken. The details of the DPR, water cut and density are manually fed into the SAP system which calculates the dry crude production by adjusting the water content from the crude oil production reported in the DPR.

- **Uran Plant:** The Uran plant receives offshore crude oil dispatched by offshore platforms and measures the quantum of crude oil received at its inlet point using Turbine Meters and Auto Samplers. The crude oil is stabilised at Uran plant in three stages where off-gas, basic sediment and water (BS&W) and condensate are separated. At the outlet of Uran plant, the crude oil dispatched is also measured using Turbine Meters.

Uran plant maintains logs of crude oil receipt and water content in it. The data regarding crude oil received is noted from the HMI of Turbine Meter at Uran and recorded daily in a log sheet, from which Excel sheets are prepared and entered into SAP system manually. Unlike the offshore platform, the Uran plant maintains electronic logs in the HMI system for previous three months. Apart from this, the physical log details are also maintained for previous three years. The lab register records manually the water cut and density of crude oil received. The crude oil receipt at Uran plant is calculated after adjusting the water cut from the crude oil

³ Turbine Meter is a primary device of Electronic Liquid Measurement System. In operation rotating blades generate frequency signal proportion to liquid flow rate which is sensed by the magnetic pick up and transferred to real time indicator.

⁴ Auto Samplers are samplers installed inline in the downstream of Turbine Meters to collect samples of liquid at regular intervals. Samples so collected are tested at laboratory to determine the water content in crude oil.

⁵ HMI is the tertiary device forming part of Electronic Liquid measurement system. It is a flow computer receiving information from Primary device (Turbine Meter) and secondary devices measuring Temperature, Pressure and Density; Using the programme instructions it calculates the quantity of liquid flowing through the Turbine Meters.

measurement. The gas separated in CSU (off-gas) is calculated using a standard formula of Gas-Oil ratio of 13:1. The water drained in intermediate and main storage tanks are not metered, but measured based on dips. At Uran outlet, physical log sheets of stabilised crude pumped to Trombay Terminal and Jawaharlal Nehru Port Trust (JNPT) is maintained.

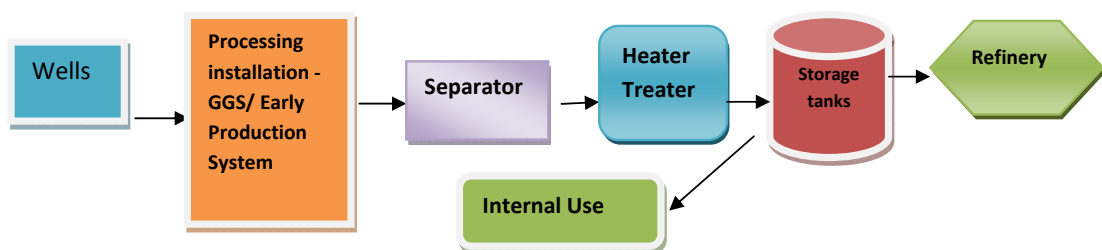
- **Trombay Terminal/JNPT (custody transfer point):** The sale of stabilised crude oil to refineries is measured at Trombay Terminal and JNPT using ultrasonic and Turbine Meters respectively for which electronic and physical logs are maintained.

2.2. Onshore areas

2.2.1. Production of crude oil in Onshore areas

Emulsion⁶ along with associated gas produced from the wells is collected at processing installations - Group Gathering Stations (GGS)/Early Production systems (EPS) through flow lines/tankers. The liquid⁷, so received at GGS/EPS, is processed through a separator where liquid and gas are separated. The separated liquid (emulsion) is stored in tanks and after stabilisation, free water is drained out. The emulsion is transported to the designated processing installation for GGS/EPS without processing facility. The processing installations will process the emulsion through Heater Treater⁸ by adding demulsifier⁹ to separate water and crude oil. The separated crude oil is stored in oil tanks at the respective processing installation and after stabilisation, further free water, if any, is drained out and crude oil with desired quantum (0.2 per cent) of basic sediment and water (BS&W) is dispatched to refineries through trunk pipelines.

Figure-3: Production of Onshore crude oil



⁶ Emulsion is crude oil inclusive of water

⁷ Water, Oil and Gas

⁸ Heater Treater removes emulsified liquids and solids from crude and also use heat and pressure drop to flash volatile vapours.

⁹ Demulsifier is a chemical used in the heater treater to separate water from oil.

2.2.2. Measurement of crude oil at onshore Assets

Crude oil is measured at the processing installations and collated at the base office of the respective Assets.

- **Processing installations:** The onshore processing installations, *viz.*, Group Gathering Station, Central Tank Facility and Desalter Plants maintain log books/ Daily production report (DPR). The measurement of crude is done through tank dips, Mass Flow Meters (MFM) and Supervisory Control and Data Acquisition (SCADA) at the processing facilities. For ascertaining the volume of liquid in a tank, calibration charts of tanks are used. The water cut is ascertained based on lab test. The crude measurement and water cut are recorded in physical logs which are then manually entered into the SAP system.
- **Base office:** The Base office of the Asset collates the information from all processing installations in the Asset and prepares the Daily Production Report for the Asset. The quantum of crude oil so recorded is reported as the production of the onshore Asset.

2.3. Audit findings

Audit findings are discussed in subsequent chapters under the following headings:

Chapter 3: Audit Findings on Measurement and Reporting in Offshore Assets

Chapter 4: Audit Findings on Measurement and Reporting in Onshore Assets

Chapter 5: Impact Assessment

Chapter 6: Conclusion and Recommendations