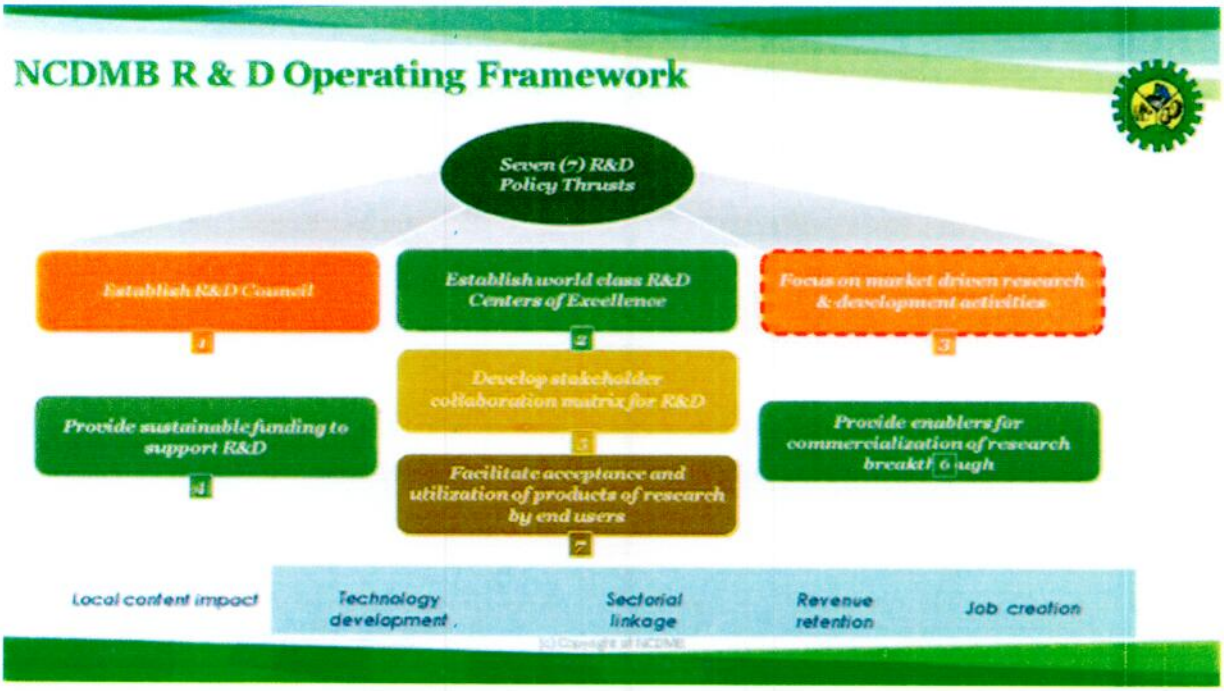
Concept for Development of Research and Development (R&D) Plan for Refineries & petrochemical Plant

Contents

1. Introduction

This concept seeks to provide a guide to any Refinery and Petrochemicals developer on the development and implementation of R&D plan for various capacities (bpd) Refinery facilities in fulfillment of Nigerian content provisions on Research and Development. The overarching objective of the concept is to drive the establishment of a R&D ecosystem that will support the Operations and Maintenance of proposed Refinery, thereby ensuring that the plant operate at optimal capacity utilization, margins and other efficiency indicators.

The concept is anchored on the NCDMB R&D framework as depicted below



2. Problem statement

Nigeria currently has 4 refineries that have been operating at less than 20% capacity utilization for decades resulting in the nation being the highest net importer of refined petroleum products in Africa. A key contributor to this scenario is the lack of well-defined maintenance programs, over-dependence on foreign OEMs to provide equipment & spares and lack of virile R&D support to the refineries. In specific terms, the bottlenecks faced by the NNPC owned refineries were:

a. There was no research Centre serving as a solution and innovation Centre for the operations of the refineries
b. There was no plan in place to develop local substitutes for raw materials used in the refineries.
c. There was no sustainable program of technology adaptation, to manufacture spares, equipment or components of the refinery units locally.
d. There was no world class institute for training and certification of refinery manpower.

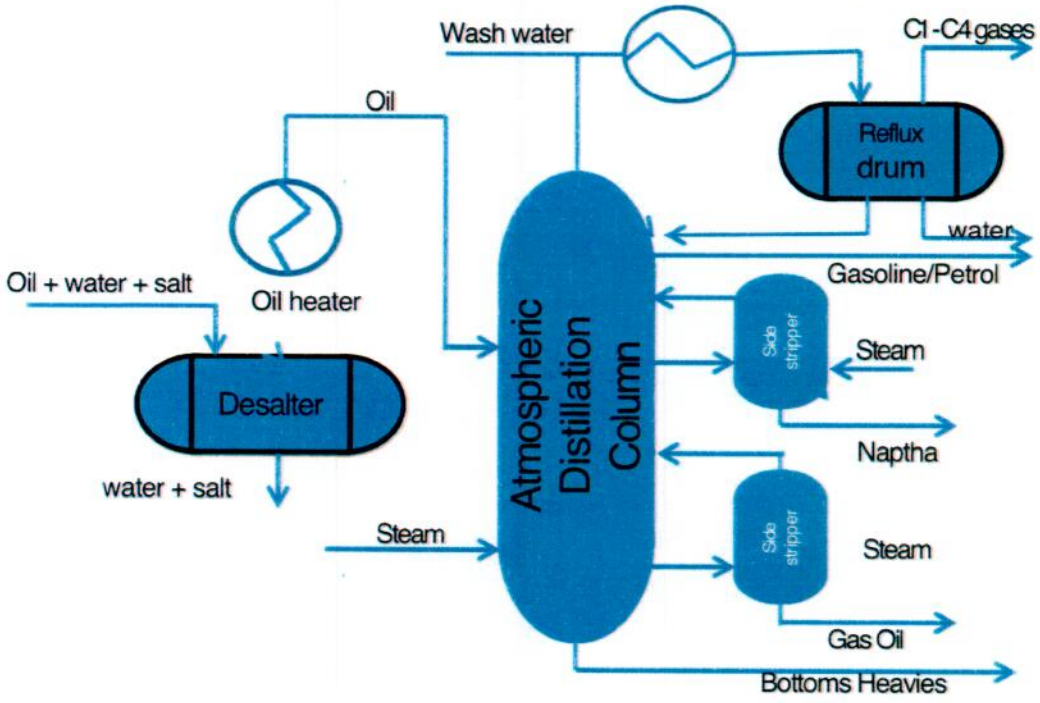
The Refinery projects are considered as major economic development imperatives to achieve self-sufficiency in local refining capacity. For these refineries to meet our national aspirations of being a net exporter of refined petroleum products, the missteps made in the conceptualization of the NNPC owned refineries must be mitigated ab-initio. It is in this regard that the Nigerian Content Development and Monitoring Board is leveraging on the provisions of Section 36-39 of the NOGICD Act 2010 to guide the development and implementation of R&D philosophy for proposed Refinery complex.

3. Refinery life cycle

Key phases of refining process are separation, conversion, treating.

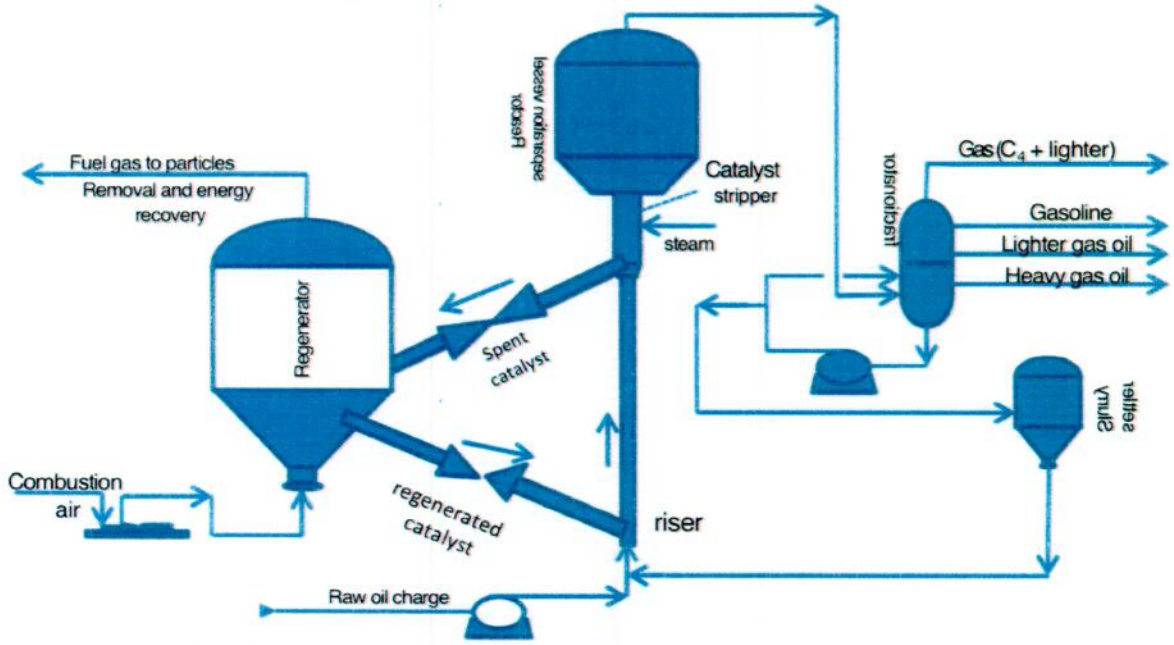
3.1 Separation

In the first step, molecules are separated through atmospheric distillation (i.e. at normal atmospheric pressure), according to their molecular weight.



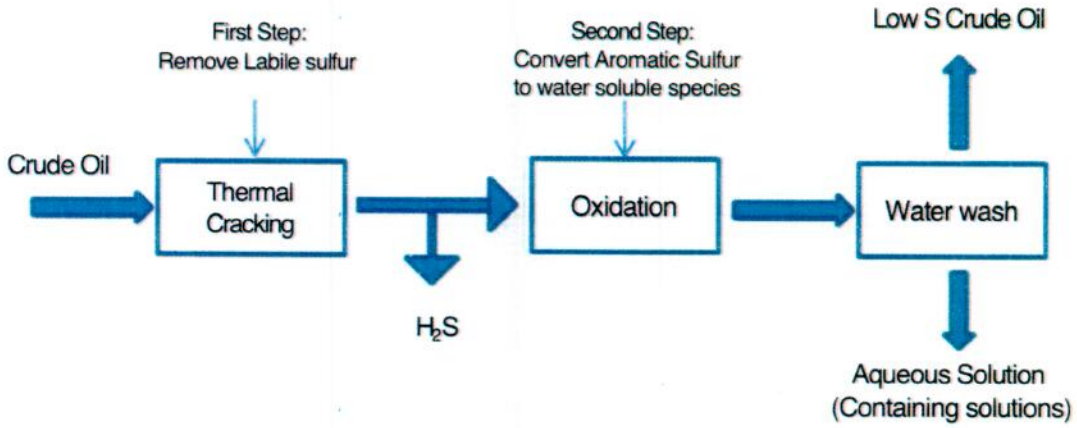
3.2 Conversion

There are many heavy hydrocarbon molecules remaining after the separation process. To meet demand for lighter products, the heavy molecules are "cracked" into two or more lighter products.



3.3 Treating

Treating involves removing or significantly reducing molecules that are corrosive or cause air pollution, especially sulfur.

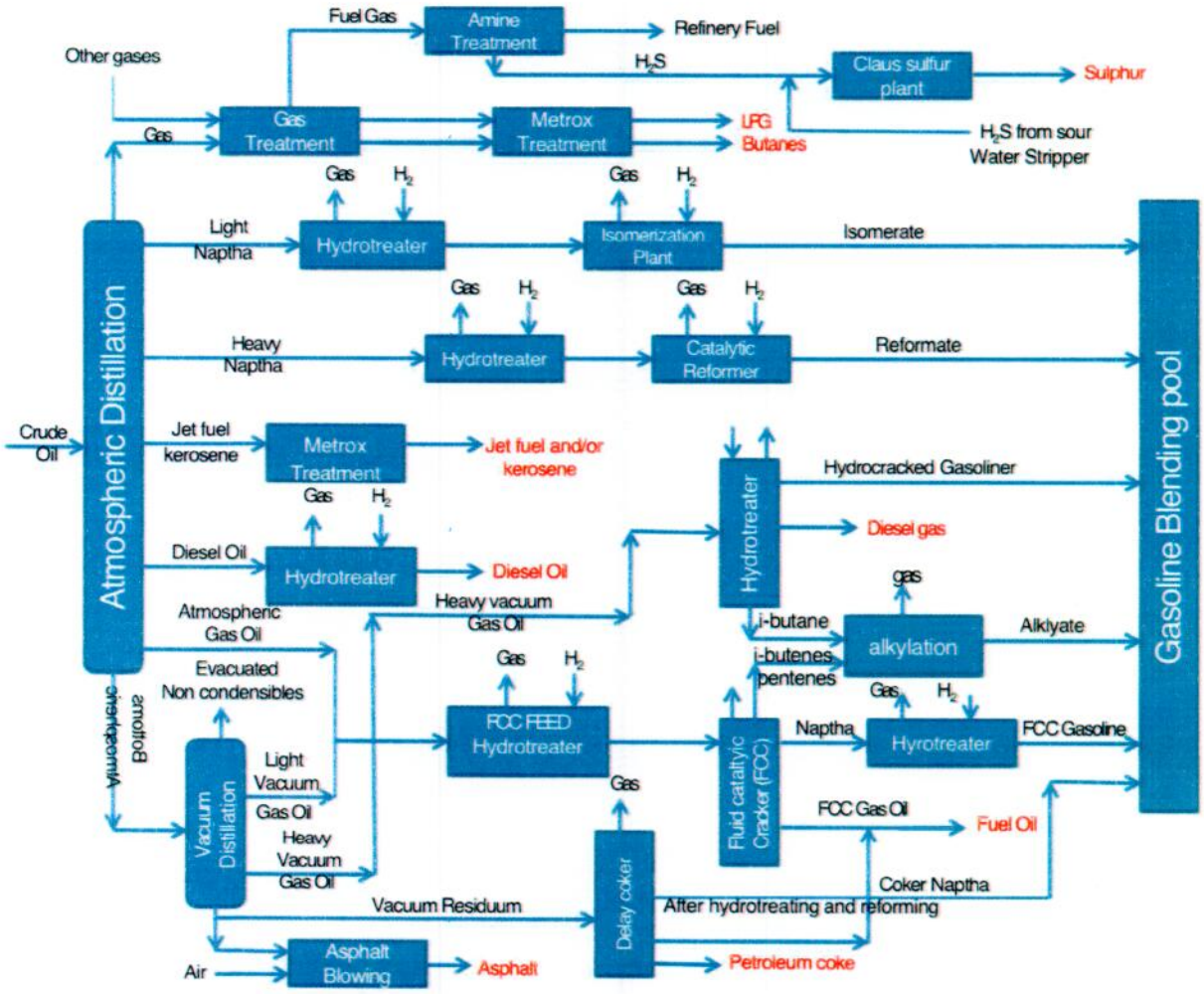


3.4 Refined Petroleum Products

It is the desire of every refinery to maximize yield in the under-listed hydrocarbon derivatives from crude refining process:

1. Liquefied Petroleum Gas (LPG), also known as butane and propane, is used as an automotive fuel or packaged in bottles and used for household purposes.
2. Gasoline and diesel are used as fuels for motor vehicles.
3. Kerosene is used as jet fuel.
4. Naphtha is a major petrochemical feedstock.

5. Wax mainly used for the production of rubbers, candle, make ups, packaging etc by the petrochemical plants
6. Heating oil is used to heat buildings.
7. Base oils are used to make lubricants.
8. Asphalt, sometimes called bitumen, is used to pave roads.
9. Heavy fuel oils used by ships



Schematic of refining process

***Finished products are indicated in Red

From the forgoing processes, proposed Refinery performance metrics will include:

a. Achieve very minimal production losses
b. Maximize hydrocarbon derivatives yield especially
c. Zero unscheduled down time
d. Deliver high quality products to customers
e. Achieve at least 90% plant capacity utilization
f. Optimize local content rating in the O&M operation
g. Create robust local supply chain supporting the refinery with services, products and manpower

h. Achieve high equipment reliability index

i. Attract and retain high performing team

The forgoing KPIs can be achieved with a robust R&D ecosystem supporting the Refinery Operations and Maintenance

4. Pillars of the R&D Plan (Proposed refinery center of excellence)

The pillars of the R&D plan shall be anchored in line with the themes of the NCDMB framework for R&D delivery:

1. R&D project – establishment of a multipurpose Refinery Research and Development Center to serve as technology solution center for Refinery operations. The R&D Center shall have the following features:

   a. Infrastructure: The Center shall be built and equipped with state-of-the-art equipment for research and training delivery in any one of the Federal Universities or Polytechnic's in Nigeria.

   b. Location: The Center may be located in any suitable Federal institution of higher learning offering Chemical Engineering or Petroleum Engineering course and located close to refinery operation

   c. Purpose: The primary purpose of the Center shall be to carry out research and investigation on technical challenges during construction, operations and maintenance in the Refinery complex. The Center will also offer technical and leadership courses for employees of the Refinery

   d. Scope: The R&D Center shall consist of 5 solution centers

      i. Materials development center– will focus on finding local substitutes for catalyst, anti-oxidants, conductivity improvers, corrosion inhibitors, octane improver, hydrogen sulfide scavenger for asphalt, dehazer etc.

      ii. Maintenance solution center- focus on proactive maintenance- work with the refinery maintenance unit to develop a proactive maintenance culture for solving identified maintenance challenges ; and develop a local ecosystem that can assist in the development of homegrown maintenance interventions

      iii. Product development center- the solution center for product development shall focus on equipment components and spare parts required for maintenance and repairs. Of interest should be bolts & nuts, valves, mechanical seals, crossover adapters, gears, switches, compressor spares, heat exchanger spares, boiler spares, insulation materials, HV/LV cables, Software, instrumentation & control units etc.

      iv. Testing & analysis center- center for testing new products and processes developed within the Refinery Solution Center before application in the Refinery

      v. Manpower training and development center- The largest Refinery in the World will obviously create enormous human capital development opportunities. Beyond the creation of employment for Nigerians, it is important to establish a training and

development center for continuous professional development of the refinery workers. The envisaged training and development center shall be attached or affiliated to an institution of higher learning (university or polytechnic) and award globally recognized certificates to participants. Capacity building for researchers working within the R&D Center will also be pursued in the manpower training and development center

2. Funding –The refinery developer shall contribute to funding the Center through annual budget provisions. The governance structure for the center shall be designed in a manner that will give Refinery administration oversight on expenditure and ownership of research breakthroughs
3. Collaboration: NCDMB shall assist in the establishment of collaboration network between the R&D Center, academia, product developers and relevant government agencies responsible for development and certification of products of research. The collaboration network will ensure value for money on research expenditures through approvals and application of research breakthroughs
4. Commercialization of research and development of startups- It is expected that over time the Center will achieve some research breakthroughs that may have commercial benefits to other refinery plants, thereby creating income stream for Refinery R&D Center. We also estimate that start-ups will evolve from the research outcomes and these start-ups will join the pool of local supply chain delivering products and services to proposed Refinery
5. Compliance with NOGICD Act- the ability of Refinery to develop and implement the R&D plan will bring its refinery operations into compliance with provisions of the NOGICD Act as it relates to R&D plans and reporting

Benefits to Refinery

1. **Minimize facility downtime**
2. **Optimize Refinery profitability**
3. **Enhance Nigerian content index for Dangote operations**
4. **Develop pool of local supply chain entrepreneurs that will provide the raw materials, spare parts, equipment components for the refinery.**
5. **Create new businesses on the back of innovative research solutions that will serve the refinery and other petrochemical plants.**
6. **Maintain healthy pipeline of talented workforce**
7. **Enhance profile of Dangote Group as a leader in exposing Nigerian academia to the intricacies operations and maintenance of a fully functional petrochemical plant.**

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Approved for implementation

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