Unleashing Values

Rare Earth in India

The Incredible Voyage of Endurance

IREL - Platinum Jubilee Year

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Dr. Homi J. Bhabha

Founder of Indian Atomic Energy Programme

"For, each man can do best and excel in only that thing of which he is passionately fond,
in which he believes, as I do, that he has the ability to do it, that he is in fact born and destined to do it."

के. एन. व्यास
K. N. Vyas

भारत सरकार
Government of India

अध्यक्ष, परमाणु ऊर्जा आयोग
व
सचिव, परमाणु ऊर्जा विभाग
Chairman, Atomic Energy Commission
&
Secretary, Department of Atomic Energy

MESSAGE

I am pleased to learn that IREL (India) Limited is celebrating Platinum Jubilee Year on completion of 70 years of its inception. I am also happy that to commemorate the occasion a Monograph titled "IREL – The Incredible Voyage of Endurance" is also being released.

I find that the monograph is comprehensive and clearly brings out the planning by DAE towards formation of IREL, immediately after independence. As a part of documentation, the journey traversed and salient milestones achieved till date are described. I feel that this will provide a very good historical background related to IREL. The present generation would be benefitted by looking at the performance of CPSE during last seven decades and also the efforts made by IREL to overcome various challenges due to the changing dynamics of the sector. This would help in understanding the way forward for IREL and take initiatives with renewed energy towards further growth of IREL.

I extend my best wishes to IREL for bringing out the monograph and also extend my heartiest congratulations to the management, executives and workmen for the Platinum Jubilee Year.

(K.N. Vyas)

राष्ट्र की सेवा में परमाणु
प ऊ वि
DAE
ATOMS IN THE SERVICE OF THE NATION

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अध्यक्ष एवं प्रबंध निदेशक
Deependra Singh
Chairman & Managing Director

Unleashing Values

आईआरईएल (इंडिया) लिमिटेड
IREL (India) Limited
(भारत सरकार का उपक्रम)
(A Govt. of India Undertaking)

PREFACE

On the momentous occasion of "Platinum Jubilee Year" celebrations of IREL (India) Limited, it is my privilege to present a compilation of monumental moments and events encompassing past 70 glorious & magnificent years of existence of IREL in the form of a monograph titled "Rare Earths in India – The Incredible Voyage of Endurance". The monograph highlights the credible vision of our founder Chairman Dr Homi J. Bhabha about the Rare Earths sector, a relevant visualisation and likely to get much more momentum in the years to come.

IREL as a company witnessed turbulent years in the past and survived in competitive world with the strength of sustainable quality products and commitment to its customers besides consistently meeting the requirement of strategic material by Department of Atomic Energy. In the fabulous journey up to platinum year of its establishment, IREL had positioned its products in global marketplace and had been instrumental in sustaining the operation of more than 2000 MSMEs in the country. By making availability of host of minerals and materials, IREL had been contributing to various sectors viz Oil & Petroleum, Automotive, Renewable energy, Real Estate and Infrastructure, Defence, Ship Building, Ceramics, Aviation, Healthcare etc. as its signature for the industrial growth.

On behalf of IREL, it is an attempt of expression of gratitude to all the past Chairman AEC & Secretary DAE including all present and past members of Atomic Energy Commission. My deep sense of gratitude to Shri K. N. Vyas, Chairman AEC & Secretary DAE for timely support and guidance for the growth of RE sector. My wholehearted gratitude to my all predecessors and to all past executives/non-executives of IREL for their untiring and dedicated work. I would also like to take this opportunity to thank all my colleague executives and workmen of IREL for their overwhelming support in this celebration and being with us in this incredible journey.....

Deependra Singh
Chairman & Managing Director

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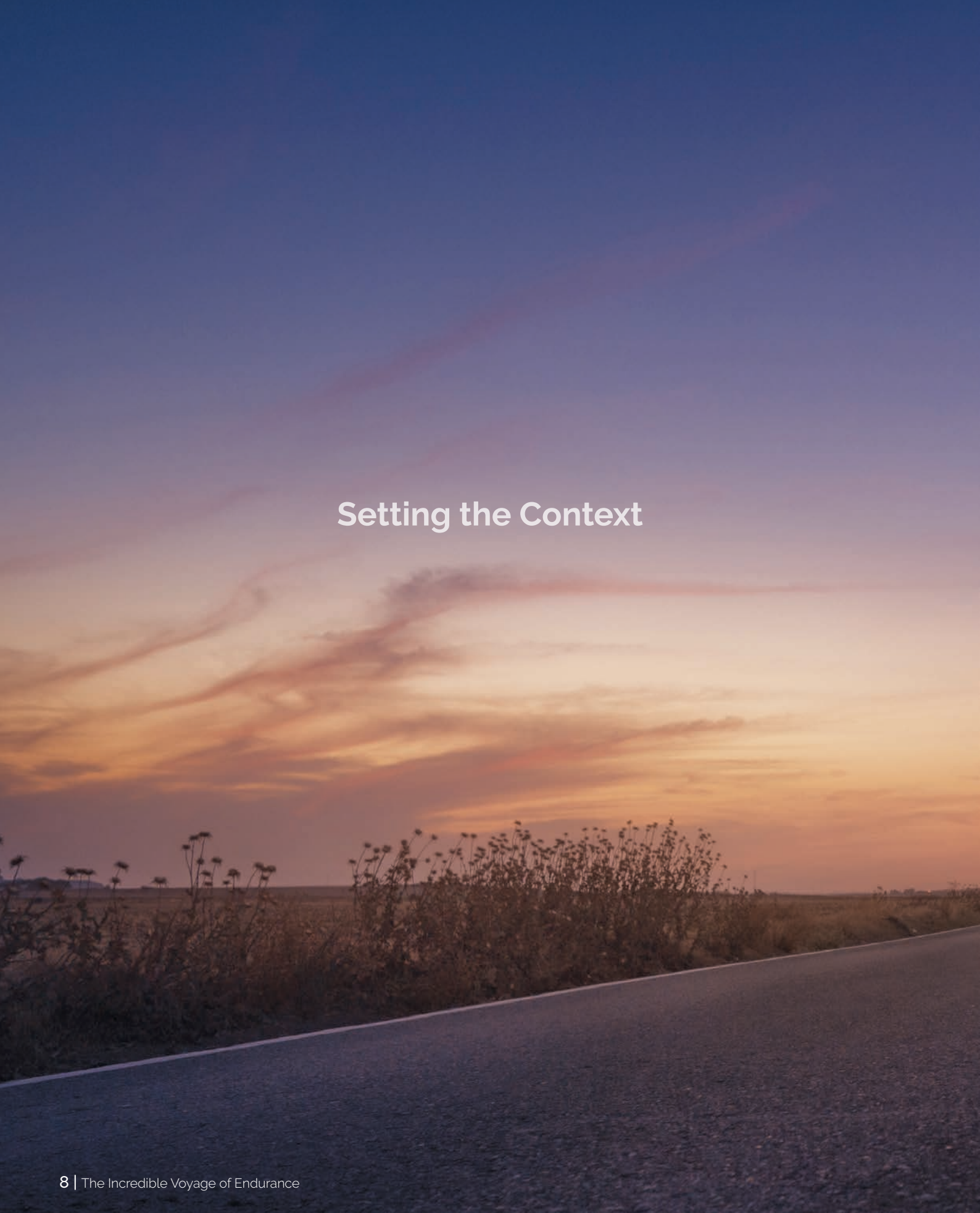


Setting the Context

A Journey of thousand miles begins with a single step.

Setting the Context

India has been blessed with reasonable reserves of beach sand minerals including Ilmenite, Rutile, Leucoxene, Zircon, Monazite, Sillimanite and Garnet owing to its strategic geographical locations. These minerals are categorized as valued atomic minerals, while Monazite is a prescribed substance for its predominant use in atomic energy programme and other strategic sectors.

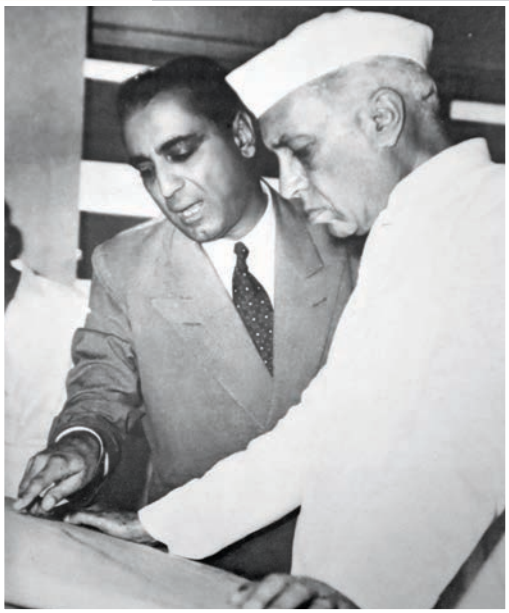
These reserves are mostly located along the coastal stretches of peninsular India with the exception of few inland placer deposits. These resources occur as beach washing deposits between the high and low tide lines along the beaches and also as inland extension of placer sands.

IREL (India) Limited

IREL (India) Limited aims to be indispensable to the global Rare Earth and mineral sand industry. It started out with establishing a single plant in South India and today it has a wide presence across Kerala, Odisha, Tamil Nadu along with ongoing projects in Andhra Pradesh & Madhya Pradesh and a diverse product portfolio.

The product range broadly includes minerals, chemicals and Rare Earth compounds. Its technological advancement is recognized in a wide array of applications with products ranging from the toothpaste used first thing in the morning to more complex roles in the nuclear industry.

In fact, today, IREL is a silent partner in the daily life of millions of consumers as its products find application in many facets of day-to-day life – be it in paints, detergents, ceramics, refractories, welding electrodes, gas mantles, petroleum products, colour television, optical lenses, etc.



Dr. Homi J Bhabha explaining the then Hon'ble Prime Minister of India, the flow sheet of MoPP

Dr. Vikram Sarabhai

Chairman, AEC

"The development of nation is intimately linked with the understanding and application of science and technology by its people"

Vision and Mission

The vision and mission of the company is focused on meeting both macro and micro objectives of nation building and value creation.

VISION

To be a significant contributor to the global clean energy mission by providing high-quality performance enhancing materials and operating in a socially responsible manner

MISSION

- To maintain a global reputation and sustainably grow the core business of heavy minerals and Rare Earths by expanding our mining, mineral processing and Rare Earth refining asset base domestically and globally.
- To adopt best-in-class sustainable and technologically advanced business processes and practices across the value chain.
- To foster long-term and credible relationships with our customers by pursuing a customer-first focus.
- To cultivate a conducive environment for continuous improvement, growth, and empowerment of current and prospective employees.
- To abide by and promote the highest standards of ethics, governance, and integrity in executing responsibilities and managing relationships.

The company and the sector passed through turbulent times across the decades and thrived amidst glorious peaks and survived the lows and has stood firm in its resolve towards achieving its objectives and the objectives of the nation at large. In recent years, the company did register a massive surge in production and a sales turnover of over 10 billion contributing to the country's growth and is poised for an even comprehensive and inclusive growth plan based on diversified projects.

You will get this in our annual reports.

So, what is new, you may ask?

And why did we feel the need to document our journey?

The Prologue-
Taking a Step Back

Everything we hear is an opinion, not a fact.
Everything we see is perspective, not the truth.

- Marcus Aurelis

Why do we document history? Is history documented only by the victors? Does it matter to document only the wins and ignore the challenges faced? Most people adopt the attitude of all's well that ends well. But isn't it equally critical to document fiascos and catastrophes as learning for the next generation?

Steve Jobs says that we can connect the dots when we look back. The difficulties, challenges and decisions taken would all form part of a larger context; these would be carefully thought through choices comprising of a mix of difficult and easy ones.

- What have been the challenges to keep the segment and category alive, so to say, in a manner of speaking?
- Would it have been better to just shut the plant and move on or was it more satisfying to keep operating it somehow and then eventually transform it into a thriving one? What kind of support is needed from an organization at such a time?
- Shutting down may be easy, but would it be feasible to begin at a moment's notice when demand kicks in?
- How much role does culture of an organization play on its growth?
- What is the fine balance between plant capacity expansion & mining leases reduction?

All rational and equally relevant questions with none too easy answers. A conundrum indeed for survival instincts in testing times. History is not always about facts and milestones. The numbers and facts reveal many a told and untold tale of wins and losses, of change and responses to it, and if the situation is seen as an opportunity or not.

Nation building needs resilience and the will to partner in the long haul. Along the way, many things change from contexts to the milieu to the environment and the perspective. The success of any company cannot be a result of a singular factor alone. Any good product development starts from the customer needs and wants and any product or service needs to factor this in. Many factors including process level efficiencies and design thinking needs to be built into the system.

Success is usually a result of strategic moves, an innate sense of market timing, a consistent execution of the way of workings of a company, a dramatic reduction of the complexities and many such factors.

So, what then is the objective behind this book?

Documenting the Story Behind the Facts

They say that a legacy is etched into the minds of others and the stories that are shared. In this book, we have tried to show you that very glimpse into our journey beyond the usual tick marks of milestones and production numbers. We hope to share with you our joys and victories, our ups and downs and laurels and perils over the years as we celebrate our platinum jubilee this year. We hope to convey what motivates us – a driving nationalistic spirit and being in the forefront of driving to a symbol of progress and powering through decades.

This book is an outcome of conversation with the ones who matter and the ones, who have put their blood, sweat and toil in nation building.

On this momentous special occasion, we wanted to tell you, our story; the difficulties and challenges at that particular time and how we as a company came out of it. We wanted this document to give you a tiny glimpse into what goes behind our workings, almost a behind the scenes in today's digital language.

At this juncture, we would like to recall the pioneers who have helped shape the industry and the company. We are indebted forever and offer our debt of gratitude to the pioneers to whom we owe our very existence. Our heartfelt thanks to Dr. Homi J. Bhabha, Dr. Vikram Sarabhai and Dr. Homi N.Sethna who built a strong vision for IREL which was proven good in the forthcoming decades. We would also like to convey our special thanks to all the past Chairman AEC & Secretary DAE and present Chairman AEC & Secretary DAE, Shri K.N. Vyas and the members of the Atomic Energy Commission.

In addition, we would like to thank all our stakeholders, employees and partners for your support and patronage across the years and hope to be able to contribute to partnering in nation building for the next 70 years.

A Mythological Perspective - Rare Earths & Connect to 'Samudra Manthan'

Sage Durvasa's curse to Lord Indra led to one of the most talked about mythological tales, the 'Samudra Manthan'. After the Devas lost their power on account of the curse, they turned to Lord Vishnu, who advised that only the elixir which resided in the bottom of the milky ocean could restore their lost strength and power.

Then began the arduous task of churning the milky ocean using Mount Mandara as the churned rod, Snake God Vasuki as the churning rope and demons to hold the head of the snake. During the churning, many valuable things came out of the ocean such as gems, a wish-granting cow named Kamdhenu, a 7 headed horse named Uchhaishravas and the elixir of life, which bestowed the powers to the Lords.

The activity also resulted in generation of a lethal poison, which had the ability to destroy the entire creation. Lord Shiva consumed the poison which turned his throat blue thereby being called Neelakantha.

You may wonder why are we going back to this old mythological tale?

The operations of IREL (India) Limited, a Central Public Sector Enterprise under the aegis of the Department of Atomic Energy (DAE) reminds one of this legendry tale of 'Samudra Manthan'.

Here is why we think so.

The company operates along the coastal stretches in the country and harnesses the naturally occurring atomic mineral deposits containing the radioactive mineral 'Monazite'. During the process of harnessing, a suite of seven minerals and Rare Earths liberated from radioactivity are made available through a long drawn supply chain to industries. These industries, mostly in the MSE sector in the value chain contribute to a global green energy drive in terms of e-mobility, oil/ petroleum refining & shipping industry, nuclear power generation and reduction in emission, besides being instrumental in adding value in niche technology.

The entire process also results in reduction of the background radiation leading to an improved environment for human inhabitation.

The radioactive material is further processed by IREL and provided for strategic applications or disposed off as per the direction of regulatory authorities, thus ensuring public safety and security.

While discharging its role towards public safety, IREL produces and supplies niche minerals and specialty RE compounds to an industry as an effort of achieving self-reliance and leading to and contributing to the 'Aatmanirbhar Bharat' and 'Make in India' missions. This is an important ingredient as a performance enhancing material for the country that aspires to be a trillion-dollar economy including development prospects in a changing geo-political situation.

In line with the analogy of 'Samudra Manthan', IREL (India) Limited is churning atomic mineral deposits to produce suite of seven valuable minerals and also extracts the much coveted Rare Earths, the much sought after elements to enhance performance of gadgets in demand nowadays, just like the 'Elixir' of life.

The number seven has its own unique set of symbolisms in religion, mythology and the workings of the Universe. It has a wide variety of meanings - seven days of the week, seven musical notes, seven colors of the rainbow and the seven wonders of the world. In fact, one can also recall the concept of Saptarishi – seven sages in ancient India.

Concurrently, IREL (India) Limited is also consummating the radioactive elements for atomic energy programme and providing minerals and products liberated from radioactivity to the downstream industries in operation.

This creates a unique symphony of pull and push and a unique amalgamation with the ultimate goal of value addition.

OUR VOYAGE ACROSS THE DECADES

Opportunity does not knock until we open the door

The Glorious Past

1900 to 1910 - Discovery in Distant Shores

The real voyage of discovery consists not in seeking new landscapes, but in having new eyes and the story of the mineral sand industry in India exemplifies this.

This century old tale like most fascinating stories has its origin beyond the seven seas. A German chemist, Herr Schomberg discovered a few coloured particles that were sticking to coconut fiber. The German attitude of attention to detail must have piqued his interest and he investigated the same. He identified the particles as Monazite, a precious mineral.

He found that the sand particles came as a contaminant to the coir imported from India and was discovered at Hamburg. In those days, Hamburg was a famous sea port and continues to be so even today. It is believed that the bundles were smeared with mineral sand when the same was stacked in the shore for lighterage to ships.

On further investigation, he traced its origin to Manavalakurichi in the erstwhile Travancore state in the southern tip of India. History will tell us that the erstwhile Kerala state in those days was an important trading fulcrum and was known in the international world for many things including its spices. This accidental discovery of Rare Earth minerals made the beach an area of scientific interest. Monazite was in great demand in those days as it was the source for Thorium, a chemical required for the manufacture of gas mantles. Electric bulbs were not much in use those days. Encouraged by this supply chain, Herr Schomberg established the first step of supply chain at Manavalakurichi (MK) in 1910 and subsequently, another source of Monazite was found in Chavara along the coastal stretch in the north.

1911 to 1940 - The Days of the Raj

Both the facilities were non-operational during the World War 1, when Herr Schomberg was arrested on charges of being a German spy. With the silence of canons in World War 1 and the emergence of victorious friendly countries, the London Cosmopolitan Mineral Company took control of these resources.

In 1920, Hopkins and Williams (H&W), yet another London based company took over the operations based on locked in value of titanium in terms of another important mineral Ilmenite found in association with Monazite. The company had been instrumental in establishing an initial separation facility and the first export of Ilmenite from Chavara began in 1922.

Those were the heady times of colonization culture. History tells us that the British ruled through bureaucracy, centralization and a one-size-fits-all approach; all essential instruments for consolidation of power in an alien land. They were also very keen to leverage the resources to benefit their own motherland. A reasonable hypothesis could be deduced that mining activity and even being employed in such operations were presumed to be almost a kind of holiday posting with low emphasis on productivity and hard work. This culture prevailed for a long time even after India got independence.

This decade saw both rising glories and declining fortunes.

High Product Demand

Indian Ilmenite had been a coveted material and had maintained a virtual monopoly in the global market as a feed source for making white titanium pigment. However, in just one decade, the demand for Monazite dwindled due to the advent of the electric bulb.

By the time the demand for Ilmenite picked up again for the manufacture of pigments, many companies had turned up to establish mineral separation plants in the rich coastal stretch from Kanyakumari to Manavalakurichi and Neendakara to Kayamkulam.

The symbiotic relationship between various factors in the environment has always had an impact on the demand and consequently on the sales and the turnover. It is indeed a fact that a complex set of factors has always governed the fortunes of the company.

Between 1921 to 1930, a second company started operations in Chavara. The Travancore Minerals Company Ltd. (TMC) took over the assets of LCMC in 1930.

In the next decade between 1931 to 1940, a third company, F X Pereira & Sons (Trv) Pvt. Ltd., the forerunner to the present Kerala Minerals and Metals Ltd. also commenced its operations in Chavara in 1932.

By 1940, four plants were working in Chavara - TMC Plant 1 and Plant 2, Hopkin & Williams (Trv) Ltd. and F X Pereira & Sons (Trv) Ltd. The plants performed so well that at one stage the export shipments of Ilmenite from all the four plants together reached dizzying heights of three hundred thousand tons.

The Lows

Towering heights often lead to steep declines. From a position of virtual monopoly in 1940, this demand dwindled in the subsequent two decades due to a variety of reasons including demand for better quality, labour unrest, difficulty in shipping, etc. These will be discussed at greater length in the subsequent paragraphs.

Along with logistical and operational challenges pertaining to the plants and the company, such older companies that began at the turn of the century bore the burden of legacy. Over the course of many decades, they had to adapt and change course which sometimes posed its own challenge to balance survival, expansion and growth.

1941 to 1950 - Shaping India's Policies and Dr. Homi J. Bhabha

Importance of Nuclear Power – Impact of World War 2

This decade witnessed the gruesome World War 2; the capacity for destruction had been so much greater than in the earlier war. Civilians had been the target as much as the military and a new unfortunate word, genocide, made its ugly debut. Many ports in Europe and Asia had been destroyed or badly damaged; bridges had been blown up; railway locomotives and rolling stock had vanished. A new world order was created. The importance of nuclear power had never been felt so strongly before.

An article in The Guardian newspaper ironically credited the war as being an accelerator. The war accelerated changes in science and technology. The world got atomic weapons, but it also got atomic power. Under the stimulus of war, governments poured resources into developing new medicines and technologies. Without the war, it would have taken us much longer, if ever, to enjoy the benefits of penicillin, microwaves, computers and even accelerated social change.

Another article in The Statesman also mentioned something to this effect. The West had built up a strong scientific and technological base as a result of the industrial revolution and scientific researches which had developed throughout the preceding two centuries culminated in such breath-taking advances during World War 2 as the harnessing of atomic energy.

Shaping India's Policies

So, from an Indian context, this formed the backdrop of the challenge that lay before political leaders, scientists, technologists and engineers when the nation announced its 'tryst with destiny' in 1947. Not only were there huge gaps to be filled, but also developed countries were continuing to advance at a tremendous pace widening the gap even further. Once India attained independence, there was a great deal of strategic focus which became the base of many of the decisions. In this context, it is important to reflect what was the importance given by the government to this sector and who were the key stakeholders who played a part in shaping the same.

Role of Dr. Homi J. Bhabha

The eminent nuclear physicist, Dr. Homi J. Bhabha is rightly called as the father of the Indian atomic energy programme. He envisioned the importance of self-sufficiency in nuclear energy in the new world order formed after the World War 2.

The Government of India realized the strategic importance of beach sand minerals and decided to intervene. The Atomic Energy Act was passed by the Government of India on 15th April, 1948

and the Atomic Energy Commission was set up in the same year on 10th August under the chairmanship of Dr. Homi J. Bhabha. One of the first steps taken by the Commission was to stop the export of Monazite and evaluate the possibility of setting up a facility of processing the mineral for production of Rare Earth and extraction of Thorium on a commercial scale. The Atomic Energy Act was promulgated in 1948, which declared Monazite as a prescribed substance and brought it under the purview of the Atomic Energy and placed an immediate embargo on its export.

Dr. Bhabha played a pivotal role in shaping the policies till the very end when his life was cut short tragically.

A New Identity

Indian Rare Earths Ltd. (IREL) was incorporated as a private limited company on 18th August, 1950 to process Monazite in light of unleashing India's potential of Rare Earth resources and production of Thorium for future use in the atomic power programme.

The entity was incorporated under the Indian Companies Act, 1913 and became a full-fledged Central Government undertaking of the Department of Atomic Energy jointly owned by the Government of India and the then Government of Travancore-Cochin. The immediate objective of the new company was to set up a chemical plant for processing of Monazite for the recovery of Thorium values in the form of concentrate and extract all the Rare Earths as RE concentrate in the form of mixed Rare Earths Chloride.

1951-1960 - Nationalistic Pride

A Global Tie-up

The construction work of the Rare Earth plant at Aluva in Kerala commenced in April 1951. The plant was set up based on technology provided by the French firm, Societe de Produits Chimiques des Terres Rares, Paris (now Solvey). This was for processing of Monazite with the focus to produce Thorium and RE concentrate. About 350 tons of Monazite was sent to the Societe de Produits Chimiques des Terres Rares, Paris, for processing under the agreement.

Global Footprint

Rare Earth Chloride and Carbonates was sold in Europe through the Societe de Produits Chimiques des Terres Rares, Paris. Thorium Nitrate was transported back to India and was held by IREL on behalf of the Atomic Energy Commission (Government of India). Later it was sold in India to bonafide manufacturers of Gas Mantles. Possibilities of sale of different products in Europe, U.K., U.S.A. and other countries were explored and negotiations were carried out.

During the year 1959 about 1,559 tons of Monazite was processed, however RE Chloride production was higher than previous year since the production was stopped then and the solution was being run to waste. Most of the sales were in Europe and Japan.

The dispatch of Thorium Concentrates to France under an interim agreement was discontinued subsequently as it was decided to stop further processing. The processing of stocks in France however continued and the stocks in France were brought to India.

In case of Trisodium Phosphate, no market was available in India and therefore efforts were made to push this by-product as a viable substitute for soda ash. The company continued to sell Thorium Nitrate on behalf of the Government of India.

Nationalistic Pride and Sentiments

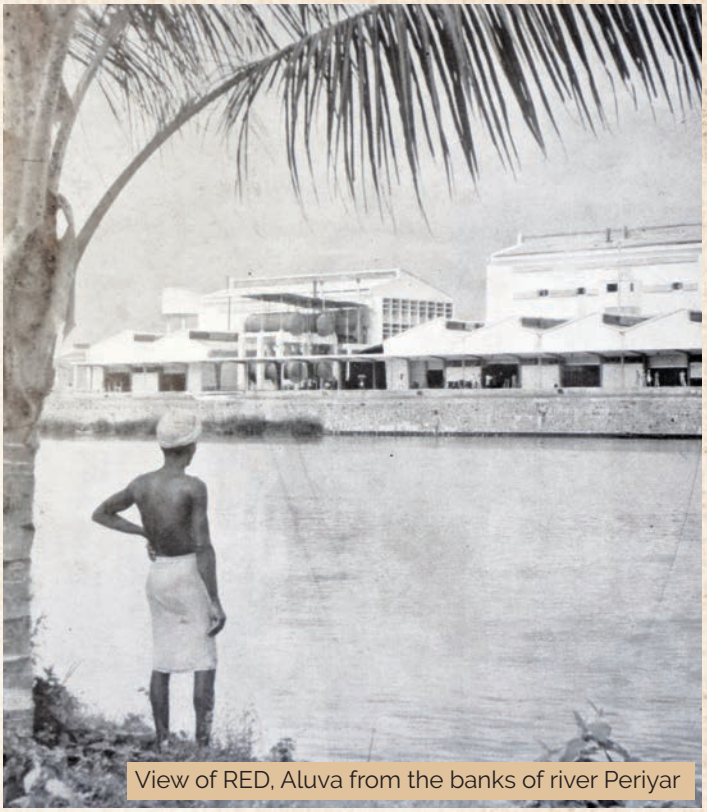
As a first step, IREL established the Rare Earths plant at Udyogamandal to make value added products of Monazite, a source for Thorium and Rare Earths. The plant was dedicated to the nation by the late Prime Minister Pandit Jawaharlal Nehru on December 24, 1952 in the presence of Dr. Homi J. Bhabha.

The core essence was summarized in what Pandit Jawaharlal Nehru had said at the time of the inauguration of IREL's first factory - the Rare Earths Plant, at Udyogamandal, Kerala. Calling this factory a symbol and promise for the future, Pandit Nehru said, "The factory is not merely a step towards industrialization but something different in quality, and deals with a substance which will play a significant part in human development". "Profit earning", he said, "was only secondary

as against the greater role IREL had to play".

Pandit Jawaharlal Nehru was in favour of what he called the concept of 'scientific temper' and wanted scientists to play a more active role in spreading this scientific temper in the country. In line with this, the Department of Atomic Energy came into being on 3rd August, 1954 which was kept under the direct charge of the Prime Minister.

During the decade, IREL was entrusted by the Atomic Energy Commission to set up a Thorium plant at Trombay. It was a matter of pride that the plant commissioned in 1955, was one of the largest in the world, meeting the requirements of the vast gas mantle industry in India as well as abroad.



View of RED, Aluva from the banks of river Periyar

Plant Construction at Alwaye/Aluva

The plant commenced with huge ambitions and was set up with global partnership and technical know-how from the West. A team from France comprising of a few individuals even set base in India in the initial stages. There were a few hiccups such as delays in shipping of machinery from Europe and U.K., delay on the part of certain manufacturers in supplying machinery, difficulty in obtaining steel in India and frequent changes made by the consultants in drawings. However, the construction was completed by June 1952 and regular production started almost immediately. The fixed capital expenditure on the construction of the plant at Alwaye was Rs. 52,99,194/-.

Over time, there was considerable labour unrest resulting in serious cases of mass indiscipline at Alwaye. As a result of workers going on an unjustified strike, the plant had to be closed down for a long period. On account of the strike, there was no production for nearly six months towards the latter part of the decade. (Extracts from Annual Reports)

Export Regulation: Ilmenite

Other than Monazite, another mineral that was exploited in those days was Ilmenite, present as a major share of mineral assay in Indian deposits. The Government of India took cognizance of this fact and regulated the export of Ilmenite by promulgation of an order called export control order of Ilmenite in 1953 which was modified in 1958. As per the control order, the limit of Ilmenite meant for export to other countries should not exceed 0.10% of Monazite as impurity to achieve

conservation endeavour in terms of control. Over the time, due to international standard of permissible radioactivity upto 1Bq per gram and considering capability of mineral separation equipment, it was increased to 0.25% of Monazite impurity.

Concerns and Issues on Disposal

Thorium was meant to be used initially by the gas mantle industry till it could be utilized for 3rd stage nuclear power generation. However, the Rare Earth produced as a by-product of the above process was not able to find a market which led to issues concerning its disposal. The company also faced challenges with respect to disposal of large quantities of RE concentrate in the form of RE Chloride due to non-availability of domestic industrial consumption and international market. The location of the plant near the sea and limited availability of land parcel also posed additional challenges with respect to its disposal.

Product Ups and Downs

Although production for Rare Earths Chlorides along with other by products was satisfactory, the sale of Rare Earths Chlorides continued to be dismal from 1953 to 1955 including dismal numbers in the U.S.A and European markets in spite of substantial reduction in selling price.

In fact, on numerous occasions, tons of Rare Earths Chlorides had been written off as unfit for sale due to deterioration as a result of long storage. Trisodium Phosphate did however find a reasonable market.

The production costs of Rare Earths Chloride and Trisodium Phosphate in India showed progressive reduction and these costs were substantially less in India than in France. It could have been reduced further if the plant could be operated at rated capacity, but for the lack of demand in domestic/international market. A small quantity of Rare Earths Carbonate and Cerium Hydroxide could also find a suitable market. There had been no market for Rare Earths in the country.

Other Constructions

The Department of Atomic Energy assumed responsibility of the Canada India Reactor Project and the Uranium Metal Plant.

This decade, in a way, would pave the way and set standards for various partnerships and had a long-term strategic impact.

During the decade, the revenue earned by the company increased from Rs. 0.16 crore in the year 1951-52 to Rs. 0.29 crore in the year 1959-60, while the share capital infused increased from Rs. 0.50 crore to Rs. 1 crore during the same period.

1961-1970 - Acquisitions, Exports and Going Global

New Promulgation

The Atomic Energy Act 1962 was promulgated with stricter controls repealing the 1948 Act. Under the Atomic Energy Act, minerals associated with Monazite were brought into the category of atomic minerals and private players were prohibited in the sector.

While sourcing raw material Monazite for RED plant, inconsistency was being experienced due to lack of sustained operations. In addition, a considered thought process established that the associated minerals occurring with prescribed substance should also be placed under the similar category. As such Ilmenite, Rutile and Zircon along with Monazite were occurring as a suite together and could not be differentiated prior to physical separation. Hence it was apt to extend the status of prescribed substance to all these minerals calling them atomic minerals. More so, Zircon itself is a coveted material for nuclear power programme to be used in reactors for fuel bundles to place Uranium.

Acquisitions

Unfortunately, the first three plants being operated by private players had to be closed in 1963 as their operations became unviable due to reasons such as labour unrest, quality issues and shipping problems. The Government of India had been looking for supply security of Monazite for the RED plant at Aluva. Thus, under the new act, acquisition of mineral processing plants became imminent.

IREL was made a full-fledged central government undertaking in 1963, under the administrative control of Department of Atomic Energy. For the sake of supply security of Monazite, the Government focused on acquisitions of companies to expand the footprint and capacity of the newly formed company, IREL. IREL took over a number of private companies (Hopkins & Williams, Travancore Minerals Limited) engaged in mining and separation of beach sand minerals in the southern part of the country and established two mineral divisions at Chavara in Kerala and at Manavalakuruchi in Tamil Nadu. Thus began the mineral operations of the company.

In fact, it is a matter of pride that both these plants are a significant contributor to the resources of the nation.

Initiatives with Government of India

IREL played an important role in many of the initiatives of the atomic energy programme and worked in collaboration in the early stages of development of Bhabha Atomic Research Centre, which was then known as Atomic Energy Establishment.

Col. G. R. Menon, MD receiving CHEMEXIL Shield for Best Export Performance from the then Hon'ble Deputy Minister for Foreign Trade Shri A. C. George

The Uranium values extracted from the Thorium plant in Trombay was first utilised in the Canada India Reactor which was popularly known as the CIRUS reactor for furtherance of nuclear research in India. IREL also assisted DAE in setting up the Uranium Mill Project at Jaduguda and completed it in record time and handed it over to Uranium Corporation of India in 1966.

Global Collaboration with Japan

The Japanese found RE Chloride to be an interesting material and initiated in-house research to learn how best it could be utilized. It can be presumed that this research could have played a key role in the subsequent emergence of the superiority of Japanese consumer electronic goods in the global market.

M/s. Wako Bussan Co. Ltd., Japan, had been added as a selling agent for Rare Earth Chloride to Japan which resulted in increased sales and disposal of most of the accumulated stocks. In order to meet the increased demand for Rare Earths Chloride, processing was stepped up to more than 1500 tons of Monazite per year. Orders were booked in advance for sale of the entire production of Chloride upto September 1961. This sudden revival of the market meant that some of the orders for delivery in the subsequent period could not be accepted. IREL had now established itself in Japan on a firm footing with increased demand continuing from Europe. In order to meet the increased demands from Japan and Europe, steps to increase the production were taken.

A trial consignment of Garnet was dispatched to Japan. 1,000 tons of Zircon were shipped in bulk to Japan to gain a competitive edge in the exports market.

Production of Lanthanum Oxide was also planned which had a demand in Japan for manufacture of high quality camera lenses. An important Japanese firm, manufacturing titanium dioxide, had also shown some interest and a lot of 300 tonnes had been purchased by them for carrying out trials at their plant in Japan with the expectation of larger offtake of Chavara grade of Ilmenite in Japan.

Global Collaborations

The Rare Earth Chloride from IREL was well received in the international market due to its consistency and good product quality.

The Rare Earth market was also reviving globally. In order to meet increased demands from Japan and Europe, in 1961-62, processing at Alwaye has been stepped up to about 1800 Metric tons of Monazite per year. Steps were taken to increase production to 3000 tons of Monazite per year in order to meet additional requirements from abroad. For the first time, orders were also booked in America.

Aviation Industry Connect

Based on the availability of locally produced Ilmenite in the erstwhile state of Travancore, a beneficiation plant was set by DCW at Tuticorin to produce Synthetic Rutile by using Ilmenite from MK. The plant was operational in the decade and IREL had first material supply contract with DCW in 1970. This Synthetic Rutile was supplied to Japan for production of titanium sponge & Metal, which in turn was provided to Boeing & Airbus for use in the aviation industry.

This was the origin in a sense of setting up value added industry in India. To add to that, India joined the club of the international supply chain by exporting value added product of Ilmenite rather than export of Ilmenite itself.

Challenges

Despite controlled economies, production costs also went up due to the increase in insurance, freight charges, incidence of duty, etc. The summer 'power cut' of varying degrees was imposed on industry in Kerala, with the result that no industry in the territory was able to meet its production target. To add to woes, irrespective of the cost of production, the price of Rare Earths had to be maintained to stay competitive globally. Since the main product was almost entirely exported, the short-fall in production also affected foreign exchange earnings.

There was also recession in the European Rare Earths market in 1963 which only compounded the issues. This occurred due to decreased demand for pyrophoric alloys all over the world and keen competition amongst manufacturers of Rare Earths products; most of whom stepped up production.

Closure of Travancore Minerals Ltd.

The Department of Atomic Energy had decided that in the best interest of the industry, Travancore Minerals Ltd. would be voluntarily wound up. Travancore Minerals Ltd. went into voluntary liquidation on 27th January, 1965.

IREL took over the assets in order to operate the minerals sand industry on a modern and more efficient manner with a view to extracting other valuable mineral constituents of the beach sands (viz. Zircon, Monazite, Rutile and Sillimanite) with Ilmenite. The acquisition of the mineral sand industry would enable the company to ensure an adequate and uninterrupted supply of Monazite for its factory at Alwaye at a reasonable price.

The trade investment of Rs.25 lakhs in the share capital of M/s. Travancore Cochin Chemicals Limited, Kerala did not materialize as the Government of Kerala declined the company's offer to participate in the preference shares of Travancore Cochin Chemicals Limited as they were not going in for preference shares.

Plants & Products Realignments

Ilmenite and Monazite were produced only at the Manavalakurichi plant. There was considerable demand for Rutile in India and for Zircon both in India and abroad. The Japanese had also shown some interest in Sillimanite.

A programme, for the modernization of the mineral sands industry had been contemplated with a view to increasing productivity and cutting down the cost of production. This industry is highly labour intensive and the cost of labour constitutes roughly 90 to 92 per cent of the total costs of production. This programme was first planned to be implemented at the Manavalakurichi plant.

The Chavara plant remained closed during the decade. The plant at Chavara was modernized and redesigned to separate Rutile, Zircon, Sillimanite and Monazite, besides Ilmenite as against operating mainly for Ilmenite for which the market was poor.

Beach sand collection from the beaches of MK

IREL set up a 10 tons per month plant, at Alwaye for the manufacture of Rare Earths Fluoride to meet the demand of the Carbon Arc Industry. It was indeed a matter of pride that this plant was designed by IREL's own technical staff based on process developed in-house and was able to meet pan-India requirements.

The shift operation at the Thorium plant had to be discontinued due to accumulation of stocks and consequent curtailment of production and alternative employment for most of the retrenched personnel was managed at the Atomic Energy Establishment, Trombay.

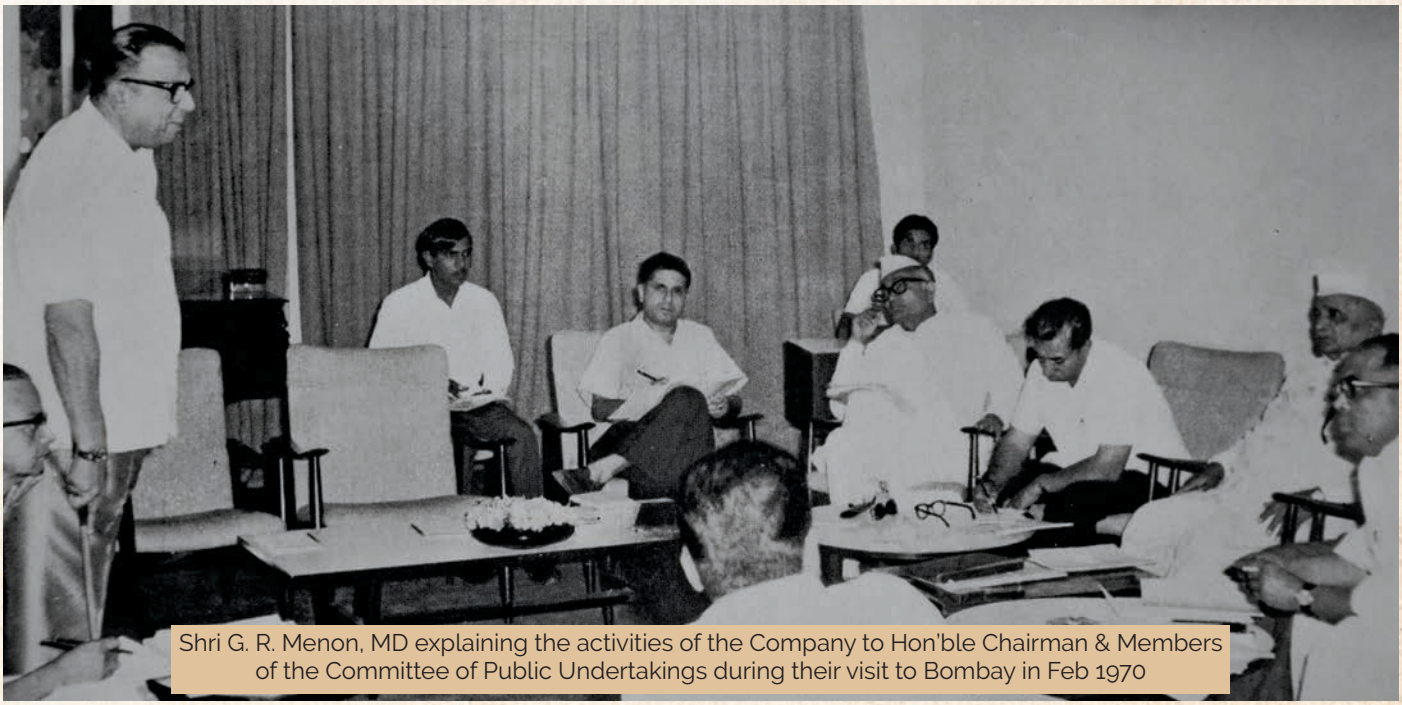
Considerable increase in Yittrium and Europium (heavy Rare Earths) was being noticed in the colour television industry.

The Fertilizer Corporation of India Ltd. at Sindrihad developed a catalyst using Cerium Nitrate for which requirements had to be regularly met.

Noteworthy Highlights

The company continued to add profit and dividend for the year ending 31st March, 1963, (amounting to Rs. 4,50,000) was paid. The substantial increase in the year-end surplus over last year was due to increased production and sales of the products at higher prices, increase in other income, viz. interest on investments, drawback on excise duty and other miscellaneous income.

About 2,933 M.T. of Monazite was processed and a record production of 300 M.T. per month was achieved in the month of August 1962. The sales of Trisodium Phosphate were substantially



Shri G. R. Menon, MD explaining the activities of the Company to Hon'ble Chairman & Members of the Committee of Public Undertakings during their visit to Bombay in Feb 1970

increased and a stage was reached when the company found it difficult to meet the entire demand.

Inspite of the devaluation of the rupee, it was possible to retain the unit sale value of the company's export products because prices were extremely competitive and the quality was consistent and good. Almost the entire turnover of Rare Earths Chloride, Ilmenite and Garnet represented export.

The sales of Rare Earths Chloride registered a substantial increase due to revival of the market; particularly in Europe where the demand was nearly double than that of the earlier year. The company, for the first time, exported Rare Earths Oxide, Rare Earths Fluoride and Rare Earths Hydrate to different destinations.

Market Outlook for Next Decade

The titanium pigment industry maintained a steady growth rate in this decade. Apart from the growth in volume, the development of the chloride route had made a big impact on the pigment industry. The pattern of consumption of Rare Earths had always been erratic and this trend continued. Over the decade, there were upsurges in demand and consequently capacity of different plants were increased to the extent possible to meet such demands.

In working with the pigment industry, attempts were made to keep pace and explore possibilities to bridge the technological gap using the chloride route over sulphate process. Feasibility studies on entering into a collaboration to set up a plant for the production of upgraded Ilmenite were proposed.

During the decade, the revenue earned by the company increased to Rs. 2.38 crore in the year 1969-70, while the share capital infused increased to Rs. 1.50 crore.

1971-1980 - Global Collaborations

Varied Uses

The Rare Earth market slowly started picking up and its applications found numerous uses in the Western world. During the decade, Rare Earths were normally used as concentrate form as mixed RE chloride. The material had a global footprint and had been instrumental in developing a variety of applications of individual REE through sustained research efforts. The material from IREL was finding applications in crude oil refining in US and Europe. The supply continued till the last decade of the twentieth century and later on, the development of Fluid Cracking catalyst based on Lanthanum replaced it. Japan could succeed in developing a high power RE magnet during the decade.

Dr. Homi N. Sethna
His visionary guidance provided new dimensions to IREL

Birth of OSCOM - Flagship Project

The Government of India visualized a potential in the supply chain of titanium and envisioned a flagship program along the coastal stretch of Eastern India. Given the success of establishment of plants in the southern shores, and the resultant setting up of value chain in south India, it was decided to set up a Synthetic Rutile plant in Orissa.

The flagship project, Orissa Sand Complex (OSCOM) at Chatrapur in Odisha was conceptualized in the early years of the decade in 1970-72. In view of the mineral assay of Indian deposits having a high percentage of Ilmenite, it was essential to have beneficiation plants of Ilmenite to taste success in the sector.

Work commenced in 1977 and plans included a mineral sands separation plant, a Synthetic Rutile plant, Zirconium Chemical plant and a Caustic Soda plant.

Consultancy agreements were signed with the Australians for the acquisition of know-how for the Synthetic Rutile plant and for selection of Indian consultants. Consultancy agreements were signed with M. N. Dastur & Co. (P) Ltd. and with Benilite Corporation of America. A contract was also executed with Carpco Inc. U.S.A. for supply of imported equipment for the dry mill of the Mineral Sand Separation Plant. Design and detail work in respect of the Dredge and Wet Concentration Plant was completed by the Australian consultants, M/s. V. G. Bennett and Associates (Pty) Ltd.




Initial days of export of IREL's Ilmenite being shifted through barges for loading at anchorage area

The estimated outlay was Rs. 38.30 crores. However post detailed evaluation by Indian consultants, the total investment on the project was revised to Rs. 85.67 crores, against the initial estimated project cost sanctioned originally which was under consideration of the Department of Atomic Energy in consultation with the Planning Commission.

The construction work was sluggish during 1978-79 due to certain policy issues. The freeze on the Orissa Sands Complex Project was partially lifted in March 1978 and was completely lifted in May 1978.

Other Plants

The mineral sand separation plant, the Zirconium Opacifier plant at Chavara (Kerala) and the Zirconium Oxide plant at Manavalakurichi (Tamil Nadu) went through its fair share of teething problems which eventually got sorted and quality and production was stabilized.

The Rutile and Zircon sections of the mineral sand separation plant at Chavara were commissioned in August 1971. Since the raw sand feed was rich in heavy minerals, lower quantities could produce the targeted tonnage of Ilmenite within a variation of five percent.

The expansion in capacity of Ilmenite for Chavara Plant and streamlining of the Manavalakurichi plant was completed. A pre-concentrator facility was added in Manavalakurichi for upgrading the lean sands from nearby dunes and the beach washings.

National Award of Certificate of Merit for Outstanding export performance in 1974-75 from Hon'ble Acting President, Shri B. D. Jatti

Leadership Stance

IREL has always a thought leader and rightly so it was given the mandate to drive the mineral sand industry. The company took various steps in this direction including setting up a modern mineral sand separation plant with a capacity to treat 650 tons per day of beach sand, ensuring that the Chavara plant reached rated capacity and also mounted a concerted marketing drive. The company has always partnered the nation in its march towards progress.

The construction of a solvent extraction plant on a pilot plant scale to produce Thorium Oxide and Thorium Nitrate was designed and supervised by BARC. It was also proposed to set up a Uranium recovery plant, Helium recovery plant, facilities for diversification in Rare Earths production and doubling of the capacity of the Rare Earths Plant.

Industry in harmony with the environment - TS canal used to bring raw sand

Value Addition of Ilmenite

The Department of Atomic Energy was also considering the feasibility of erecting a pilot plant for electro smelting Ilmenite as a research project under their aegis. The project was under consideration to be undertaken by the company as part of its R&D efforts with loans obtained from DAE.

The Project Document Request in respect of the pilot demonstration plant for electro-smelting Ilmenite was submitted to the United Nations Development Programme (UNDP), New York. However, no fruitful outcome could be materialized.

Concerns

1972-73 was marked by widespread drought in the country, power-cut and rising prices and erratic supplies of essential raw-materials. 1973-74 was characterized by a slow down in the economic growth and an unprecedented shortage and rise in prices of raw materials.

At a time when the Rare Earth market was widening, the company was not in a position to fully exploit the opportunity as it had to depend on an outside source for caustic soda. This led to examine the feasibility of its own caustic soda plant which could meet likely requirements of hydrochloric acid in other units of the company.

The sales of Ilmenite fell considerably in the year 1975-76 owing to a major recession in the titanium dioxide pigment industry, as a result of which the titanium dioxide pigment producers requested world suppliers of Ilmenite not to insist on specific performance of contracts for the purchase of Ilmenite. The fall in the export of Ilmenite was largely offset by the increased exports of Rare Earths Chloride.

Making a Mark Abroad

The export promotion tours and overseas marketing delegations led to a diversification of clientele, better price realization and paved the way for entry into new markets. The company obtained an order from Taiwan for the supply of 40,000 tons of Ilmenite and expanded its export markets by exporting Rutile to Iran and Egypt.

Landmark Numbers

The capacity of the Chavara plant was increased from 1,00,000 to 1,30,000 tons of Ilmenite per annum during 1973-74.

The year 1976-77 could be described as a landmark and was the most successful year till that time as sales, profits and foreign exchange earnings of the company registered a record increase and surpassed all previous records. The major contribution to this creditable achievement came

from the record export of Rare Earths Chloride followed by export of Ilmenite, Zircon, Rutile and Zirflor. The capacity of the Rare Earths Plant had also been utilised to the fullest extent during the year.

1977 was also a year of the company's initiation to CSR and it contributed a sum of Rs. 9,456/- by way of donation for various educational, social and charitable causes.

During the decade, the revenue earned by the company increased to Rs. 10.25 crore in the year 1979-80, while the share capital infused increased to Rs. 11.52 crore.

1981-1990 - New Avenues and Better Revenue Realization

This decade can be best described as a change driver in many ways. We often think of change as only being external but internal changes are even more critical. During this decade, questions were raised on the effectiveness of the plant, its sync with technology and such other aspects. All of this resulted in many a self reflection which led to productive improvements in the plant.

Industry Opening Up

In the Indian context, the partial opening up of the minerals industry and the strategic importance to MSEs witnessed a number of small industries that began operations in the value addition initiative of the sector. This led to a renewed focus on operational efficacy towards mineral extraction operations for IREL and efforts were made to improve recoveries of minerals like Rutile and Zircon. Most of the MSEs started building their industry plan using these products and consumption of mineral products enhanced in industry in a complementary manner.

Global Upheavals

A new world order was yet again beginning to be created. China started working in a big way in the field of Rare Earths and exploiting its resources to the fullest. On the other hand, the Western world was abuzz with newer regulations, companies going bankrupt, banning of ecological harmful materials and environmental concerns taking centre stage.

Many first world countries like US and Japan had difficulty in capping their emissions and they put a stop to mining activities in their country and started literally searching for countries where they could shift such industries. Who benefitted? Naturally, countries that had relatively lax rules and more agile responses benefitted. One of the biggest beneficiaries of the shifting of the Rare Earth industry to Asia was China which took giant strides in this sector, generated employment opportunities, ensured economic growth and also consolidated their position in value added products. There were also numerous research activities in this sector and a number of the initial patents for innovations could be attributed to Japan and China.

New Products, New Markets

Necessity is the mother of innovation and innovation gives rise to immense possibilities. A new product Garnet was introduced and a new user industry sector was developing around this product. Some efforts were made to diversify the product range on a small scale by producing compounds of individual Rare Earth, Zirconium chemicals and Zircon based products. Incessant efforts to find export markets for 'MK' grade Ilmenite solved increasing inventory issues.

In the case of Rare Earths, there seemed to be some change in the usage pattern in the world,

thus necessitating diversification of the product range; steps were taken by the company in this direction and a project for separating various elements from mixed Rare Earths was also taken up.

However, the over-supply of Rare Earths in the world markets did pose a grave threat to the marketability of Rare Earths Chloride – a product which was the mainstay of the company. There was continuing demand for other key products like Rutile, Zircon and Trisodium Phosphate. During 1984-85, the demand for diversified products like Samarium, Gadolinium, Yttrium and Europium concentrates picked up.

Digestor in operation in SRP, OSCOM

OSCOM

While the Rare Earth market continued to be an important revenue source, the flagship plant of OSCOM was commissioned for production of Synthetic Rutile. However, ramping up was slower than expected.

At OSCOM, production performance had not been to the desired level due to various technical glitches and efforts were taken to overcome them. However, non-completion of port facilities at Gopalpur by the State Government was a major handicap in exporting Orissa products and affected overall profitability.

Acid Regeneration Plant & Supplementary Mining Plant, OSCOM

Dredge in Operation in MK

The production performance was not upto to the desired level due to above stated technical glitches. Under the terms of the agreement, M/s. Kerr McGee Chemical Corpn., USA, who were operating a plant for Synthetic Rutile similar to OSCOM, had deputed their engineers to suggest remedial steps to overcome the problems. Arising out of their suggestions, suitable measures were being taken. In fact, discussions were also held with Ruthner of Austria and Krebs to improve the performance of the Acid Regeneration Plant.

Operational Challenges and Solutions

The company did take steps to overcome the problem of depleting quality and quantity of raw sand in minerals division. A Dredge and Wet Concentrator facility was set up at Manavalakurichi in record time, which was inaugurated by Dr. Raja Ramanna, Chairman, Atomic Energy Commission & Secretary, Department of Atomic Energy.

During 1984-85, the Dredge and Wet Concentrator plant at OSCOM had already commenced operations and produced over a lakh of tonnes of concentrate. The Dry Mill too has been commissioned and the trial runs were in progress. About 30,000 MT of Ilmenite had already been produced.

The work on commissioning of Synthetic Rutile plant was in the final phase and faced hurdles in operations.

Dr. M. R. Srinivasan, Chairman AEC along with Board of Directors and Employees at Chavara Plant

Research & Development Focus

The Research & Development set up was strengthened with a mineral separation laboratory in the plants in the southern states. There were collaborations with the Mineral Development Board and the Dept. of Science and Technology on development of various processes.

Modernization Initiatives

The Thorium Plant had become very old and beyond economical repair, and was based on out-dated process. Hence it was decided to replace the plant with a new plant based on the solvent extraction process developed by BARC at OSCOM.

Plans to modernize Chavara for better recovery of minerals were also drawn and undertaken. A Dredge & Wet Concentration facility at Chavara was set up. The modernization scheme of Dry Mill at Chavara was inaugurated by Chairman, Atomic Energy Commission in February, 1988. These measures led to substantial improvement in the production in the Minerals Division.

In the Rare Earths Division, MOHUR Project (Modernisation of Helium & Uranium Recovery Plant) had been completed and commissioning trials were underway. Work on HERO (Heavy Rare Earths Oxide Plant), a project for separation of heavy Rare Earths which are value added materials, was also in progress.

In order to overcome the power problem, a Captive Power facility was set up at the Rare Earths Division, Kerala. This was inaugurated by Shri K.R. Narayanan, Hon'ble Minister of State for Science & Technology, Atomic Energy and Ocean Development in August 1989 with Shri. S. Krishnakumar, Hon'ble Minister of State for Information & Broadcasting gracing the occasion.

Morale Boosting Visit of Hon'ble Prime Minister

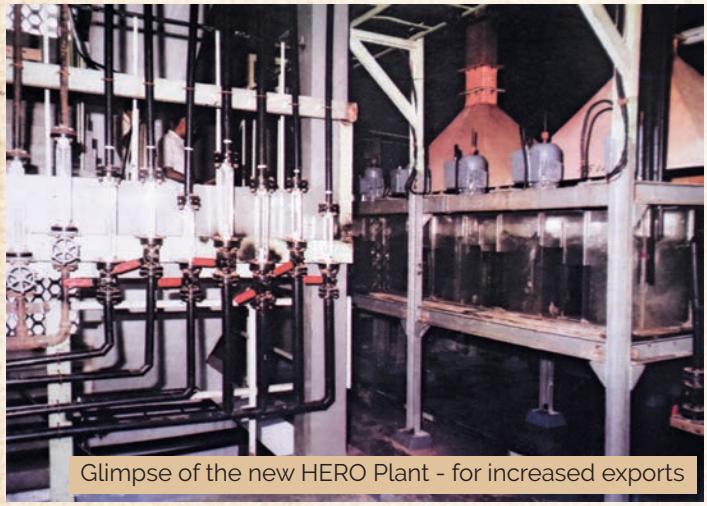
In September 1985, the Hon'ble Prime Minister, Shri Rajiv Gandhi visited the Chavara plant to see firsthand the mining operations being carried out and interacted with the workers and staff, which boosted the morale of the staff working in Chavara.

Some Financial Milestones of the Decade

Foreign exchange earned during 1988-89 rose to Rs. 29.94 crores. Another milestone during 1986-87 relates to the Rs. 135 crores OSCOM project, which went into commercial production with effect from 1986.

A One-stop Shop

By now, IREL was known in the world market as a prominent producer and exporter of beach sand minerals and Rare Earths with both international as well as domestic markets showing an upward trend and the company consistently earning valuable foreign exchange for the country.



Glimpse of the new HERO Plant - for increased exports

In fact, the company had enjoyed a unique position of having a wide spectrum of products – from mineral sands, Rare Earths to Thorium production facilities. Moreover, it has always been an almost silent partner and ally to millions of customers with its products finding application in many facets of daily life from paints, detergents, ceramics, refractories, welding electrodes, gas mantles, petroleum products, colour television, optical lenses, etc.

An Optimistic Outlook

The decade ended with an optimistic outlook towards the future. Given the abundance of resources of beach sand minerals, IREL planned to expand the existing plants to the maximum extent possible and also to develop new deposits. In light of this, there was also pro-active action and dialogue initiated with the Government of India to obtain registration as Export House in order to avail the various benefits available to export industries. The company also obtained registration as Trading House from the Govt. of India.

The then CMD, Shri R. K. Garg receiving CHEMEXIL's top award TRISHUL
for outstanding export performance from Hon'ble Union Minister, Shri N. D. Tiwari

Looking to the Future

Although Rare Earths have been produced in the country for the last about 35 years, their consumption within the country had never exceeded 10% of the production. The rest 90% was always exported to USA, Europe and Japan.

With a view to creating an awareness within the country on the potential of Rare Earths and generating an interest amongst researchers and the industrial community to take up areas of research and production based on Rare Earths, the company organized a symposium on "Rare Earths – Applications and Technology" in 1986.

During the decade, the revenue earned by the company increased to Rs. 63.96 crore in the year 1989-90, while the share capital infused increased to Rs. 63.23 crore.

1991-2000 - Emergence of China

Winds of Change

The 90's brought about a sea change in the Indian context with the opening up of the industrial policy and explosion of the sector to also include the private participation. This also reflected in some fundamentally difficult decisions which had to be taken like shutting down some plants. There was also an attempt by IREL to start new mines in Andhra Pradesh, Kerala and Tamil Nadu.

The private sector in general did not show a roaring interest and only a few players based on inhabitation in deposit area did show interest and set up facilities. In 1998, the 'Policy on Exploitation of BSM Resources' was introduced by opening up the beach sand industry to private companies except for recovery of Monazite and its processing. This decade also saw the emergence of China as a major global player in Rare Earth.

Industrial Troubles

IREL went through its fair share of industrial relations issue and management v/s workers unrest with differing expectations and benchmarks. This of course continued over a significant period of time which meant roadblocks and inefficiencies creeping in and focus shifting to resolution of issues of the union rather than increasing the demand.

OSCOM

In OSCOM, production in Mineral Sand Separation Plant had been suspended from October 1991 due to huge inventories and severe market/cash constraints which resumed in 1992. Synthetic Rutile Plant also continued to remain suspended. A six week trial run of Synthetic Rutile Plant after certain modifications showed encouraging results.

In OSCOM, ramp up operations could not succeed due technological issues although there was an established market for the product. These issues pertained to disruption in continuous operations due to blockade of roasters. Synthetic Rutile at OSCOM could not be produced equivalent to the grade produced in south India and utilization factor was also quite low, therefore the sustainability of operations itself was becoming questionable. Hence efforts were initiated to look at the market for OR grade Ilmenite.

Other Plants

Due to continuous operations of Monazite processing at RED, Aluva and storage of radioactive Thorium Oxalate residue, the regulatory wing of Atomic Energy, Atomic Energy Regulatory Board (AERB) observed that radioactive levels were approaching to benchmark level in RED Aluva unit, where Rare Earth operations were concentrated. The AERB did not grant permission for further operations till safe disposal of activities was ensured. There was pressure mounting on the units

and in turn on the company to control this level and dispose of the same in a more effective manner as per prescribed norms. It was also meant for extraction of other strategic elements for DAE.

At Manavalakurichi (MK), there was a downward trend in collection of sand due to resistance from local inhabitants which resulted in lower production of Ilmenite and Rutile. Later, the production in Chavara and Manavalakurichi did substantially increase and a major increase was seen in high value products such as Zircon and Rutile.

The increasing radioactivity level at Thorium Plant at Trombay also led to the decision of closing down the plant and look for new facilities at Odisha. In the Southern states, a modernization drive was initiated.

Emergence of China

China emerged as a flexible destination for processing of Rare Earths, hence the US started exporting their RE ore to China. Thus, on one hand, China got enough ore to process stemming off its vast resources and the western world got a much-needed solution to their environmental concerns. This enabled China to supply Rare Earths at a much lower price in the global market. The Indian cost of production could not match upto Chinese levels. Statutory, regulatory and market conditions were slowly making circumstances difficult for the RED unit to continue.

Market Dynamics

Sale of Ilmenite demonstrated the potential of profit earning and improving the sustainability, therefore a conscious decision was made to shut down Synthetic Rutile operation and switch over to Ilmenite sale. The development of market for sulphate grade Ilmenite was not coveted by that time; hence it required extensive efforts to establish its market in Japan, South Korea and Europe. However, the initiatives turned around the company into profit and in this decade it joined Rs 100 cr club in the first instance and later Rs 200 Cr. However this story was reversed in Rare Earth sector.

Dr. P. K. Iyengar, Chairman, AEC laying the foundation for the Light Rare Earths Extraction Project at RED, Aluva

The Zircon market was showing signs of distinct recovery, Garnet & Sillimanite in domestic & international markets and Rare Earths demand began to show stability and growth. OSCOM did achieve its targeted production but it was also

subject to severe damages caused by the cyclone in October 1999 and consequently the plant had to be shut down for about a month and a half.

New Initiatives

The commissioning of the New Thorium plant in OSCOM was underway as was commencement of pre-project activities in the case of green- field deposits at Ayiramthengu in Kerala, Kudiraimozhi in Tamilnadu and Bhimlipatnam in Andhra Pradesh.

Dr. T. K. Mukherjee, CMD along with the SCOPE Award for Excellence and Outstanding Contribution to the Public Sector Management, presented by Hon'ble Vice President

In case of Ayiramthengu, setting up of a joint venture project for mining, minerals separation and production of Synthetic Rutile is under consideration. In case of other projects, pre-project activities like environment studies, clearance from various agencies, acquisition of land etc. are in progress.

A fully functional Mineral Research & Development Centre (MRDC) facility was set up that catered to both in-house and outside development work. IREL also actively participated with BARC to set up a Rare Earth Development Laboratory at Trombay and worked in collaboration with Defence Metallurgical Research Laboratory, Hyderabad to steer the efforts of Titanium Development Advisory Committee in the area of Ilmenite beneficiation.

In 1993-94, a landmark was achieved on crossing the Rs. 100 crore sales turnover and 50 crore foreign exchange earnings.

During the decade, the revenue earned by the company increased to Rs. 214 crore in the year 1999-00, while the share capital infused increased to Rs. 85.97 crore.

2001-2010 - Legal and Statutory Hurdles

This decade had its fair share of tumultuous happenings. The conditions were clearly not for the faint-hearted and would have made a less tough company and management crumble under pressure but IREL did hold out to eventually emerge like the proverbial phoenix.

Hon'ble Defence Minister, Shri Pranab Mukherjee presenting the National Safety Award (Mines) for the year 2001 to Shri K.P.Sreenivasan, Head, MK Plant

Renewal of Leases and Legal Hurdles

The opening up of the sector did pose challenges. A few players from the private sector emerged and this had an impact on renewal of existing leases. Many a time this led to different state governments reducing the scope in new leases or sometimes even outright cancelling existing leases on self-proclaimed technical aspects. There were many legal cases around this time and in a few cases, there was even incongruity in the decisions of the local courts versus the High Court. Court cases, legal matters, response to various RTI applications pretty much dominated this time span with newer laws only further complicating the matter. Even in the case of green field projects covering deposits in Kudiraimozhi, Tamil Nadu and Bhimilipatnam, Andhra Pradesh, all related activities came to a standstill in view of denial of environmental clearances.

Shri S. Gopal Krishnan, the then Director (Finance) launching the souvenir on Science, Technology & Application of Rare Earths organized by REAI

Push-back: Stagnation in Plant Capacity

In order to increase production capacity, it was decided to initiate expansion programmes in the mineral processing plants at Chavara. This could not be initiated in MK because of regulatory

Shri Prithviraj Chavan, Hon'ble Minister of State in PMO visiting MK Plant in the presence of Dr. Anil Kakodkar, Chairman, AEC & Secretary, DAE

issues related to the State Government. Multiple socio-political issues in Chavara led to disruption in activities like mining and transportation of materials to the plant. Consequently, the company managed to increase the installed capacity only at Chavara. All of this meant that by the end of the decade, there was a drastic reduction in the capacity utilization in the MK plant for want of surface right and mining issues.

By the end of the decade, there were serious concerns on the operation of the MK plant based on its life of mine, dominance of private players in and around IREL mines and lack of state assistance to PSU operations. Regulatory pressures and market dynamics proved to be real operational constraints at RED plant, Aluva making it almost unsustainable. As a result, the overall annual turnover and production levels remained stagnant.

Hon'ble Minister of State for Mines, Shri Ramesh Bais presenting the Subhkaran Sarawagi Environment Award 2002-03 to MK Mines

Re-alignments

The beginning of the new century also witnessed closure of Monazite processing operations in RED, Aluva on the recommendations of the statutory body, AERB. The operations of the plant were retrofitted and IREL took up THRUST Operation (Thorium Retrieval Uranium Recovery Restorage) to process the crude Thorium hydroxide stored in silos to recover the coveted strategic values and store the Thorium values in purer form as Thorium oxalate.

It was planned to establish Monazite processing operations on a higher scale in the OSCOM unit. The Rare Earth Extraction Plant (REEP) was planned with a capacity to process 10,000 tpa of Monazite. To add value to the mixed Rare Earths Chloride produced from Monazite processing operations, the operations of IREL in RED, Aluva were required to be modified based on in-house R&D to set up a plant to produce separated high pure Rare Earths.

Focus on Long-term

In 2002, The Indian Rare Earths Research Centre (IRERC) was set up at Kollam in Kerala. This corporate R&D centre was fully equipped with a state-of-the-art research laboratory and sophisticated equipment. In fact, the pioneering research at all the R&D units are recognized by the Department of Science and Industrial Research (DSIR), Government of India.

Shri V. K. Verma, Director (Marketing) receiving the CAPEXIL Export Award, 2002-03 from Hon'ble Minister of Commerce, Industry, Law & Justice, Shri Arun Jaitley

Eventually, IREL did turn around its fortunes and transformed from a loss making company to one that made profit and increasing PAT in subsequent years.

During the decade, the revenue earned by the company increased to Rs. 337.10 crore in the year 2009-10, while the share capital infusion increased to Rs. 86.37 crore.

THE TRANSFORMATIVE PRESENT

2011-2015 - Disruptions Galore

The decade may be broadly divided in two parts; the first phase (2011-2015) was when things almost seemed down in the dumps and the second phase (2016 to 2020) which was the turn-around.

Policy Matters

The impact of policy changes started reflecting in the working of the sector during the first phase. Irrespective of volume of reserves, every mineral had its own market outlook based on the factors on which it broadly depended. Moreover, the overall mineral exploitation is the result of policies and the direction that the sector needs to move at that stage.

As such BSM & Rare Earths sector are characterized by limited market potential and the development of market would depend upon the mineral assemblage in the specific type of deposit. This is especially true in case of Indian BSM consisting of suite of minerals wherein each one has its own value chain and RE extraction itself is a part of value chain of Monazite. With limited market outlook, associated factors would start displaying the impact. During this phase, IREL struggled with continued agitation in the vicinity of mining area; surface right issues coupled with statutory requirements impacted mining output and production negatively.

Legalities, Clearances & Disruptions

The existence of IREL predated the various acts and rules mandating prior clearance pertaining to Environment & CC, Forest and CRZ. However, there were many misinterpretations of facts which led to IREL taking a hit on its image perceptions and caused many a havoc including RTI applications, court cases and unfair negotiations by trade unions who took advantage. Looking at the performance of sourcing of raw material from mines and the production, the trade unions became uncomfortable and tried to enhance their negotiation power.

It is said that limited market potential would lead to monopoly even if one tried to create a level playing field and opened up the field for multiple players to emerge. This is what exactly happened. Conditions continued to play spoilsport.

Disruption in mining and transportation of feed material to mineral processing plants, newer issues such as excessive infeasible demands for surface right affected the operations of Chavara and MK units coupled with reduction in accumulation of beach washings. The dredge was also passing through the lean grade areas resulting in reduced production in the OSCOM plant.

The company survived the initial two years under improved demand scenario in market even after reduction of production, but later it had to combat natural calamities in terms of a series

Dr. R. K. Sinha, Chairman, AEC inaugurating IAEA Conference on Thorium at Kovalam, India

of cyclones in Odisha and stoppage of work in some of the southern mines including MK mines almost completing its lifespan. Such situations led to extreme stress on the operating performance of the company.

Pending lease renewal, struggle with various statutory compliances, unutilized plant capacity due to regulatory challenges, upgrading of obsolete technology – all continued to be a bone of contention.

New Initiatives

In order to meet the obligations of Government of India, IREL had taken up the challenge to set up a new Monazite Processing Plant in the OSCOM premises at Odisha and refining plant to produce High Pure Rare Earths (HPRE) at RED Aluva. The process of setting up new MoPP / RE plant at Odisha with increased capacity had its own regulatory challenges. In addition, it was imperative to hunt for a buyer to consume the huge capacity of RE concentrate and other by-products.

Since no other plant was working in the sector, the expertise in upscaling of equipment construction brought with it, its own constraints. Even though the plant was ready, teething troubles meant it took a long time to set up operations. Factors included very old technology of the 1940's, material of construction to withstand corrosive material, limited availability of engineering company's in India to take up RE specific work etc.

IREL had also set up the refining facility at RED, Aluva, for production of High Pure Rare Earths, which was a first of its kind facility in India. A second 10 year long term plan has been prepared with an ambitious outlay in terms of CAPEX focusing on value added products, but implementation could not be commenced.

Reduced production of minerals & mining output, impact of Phalin and Hudhud cyclone, new facility for processing of Monazite & Rare Earths, surface rights and disruption issues led from socio-economic factors precipitated the situation of operating loss in 2014-15 and ended up with a huge loss to the company to the extent of more than +30% deficit by the year 2015-16. The future started looking bleak and it drastically needed 'infusion of oxygen' for survival in terms of a re-defined strategy and approach.

During this period, the total revenue earned by the company increased to Rs. 352.26 crore in the year 2015-16, while the share capital infusion remained same.

2016-2020 – The Revival

Revival and Turn-around

This phase commenced with thought leadership for future outlook. IREL learnt from its mistakes and started undoing the steps to overcome the shortcomings in the second phase of the decade. A strategic plan was drawn incorporating the achievable milestones in line with the mandate of the company keeping aside the ambitious corporate plan prepared in 2011 by focusing on capital investment beyond the size of the company.

The new strategic plan prepared in early 2016 focused on horizontal and vertical expansion in a balanced manner with attention to 360 degree improvement stemming on six pillars i.e. business, operations, sustainability, capital project management, human resource development and IT strategies. SWOT analysis, brainstorming of innovative ideas and dedicated efforts for implementation all formed part of the plans for revival.

Statutory Clearances

The first and foremost attention was given to pending statutory clearances, which were pending for long by formation of a focused team called 'License to Operate' approach with firm set timelines for obtaining the same. Operational improvements, up-scaling and innovations went hand-in-hand with operational and regulatory challenges. The support of DAE was successfully obtained for straightening such ambiguity which was working as impeding forces. Obviously such acts were not viewed very favourably by many of the stakeholders who were in fact instrumental in disrupting the operations of IREL with the help of imbibed.

Incidentally, at this point of time, the Government of India upon stoppage of mining by Govt. of Tamil Nadu and Govt. of Andhra Pradesh on reported allegations of illegal mining by private players and corresponding court cases issued a notification commonly known as 0.00% Monazite notification in 2019 and canalized the export of BSM through state agency, IREL.

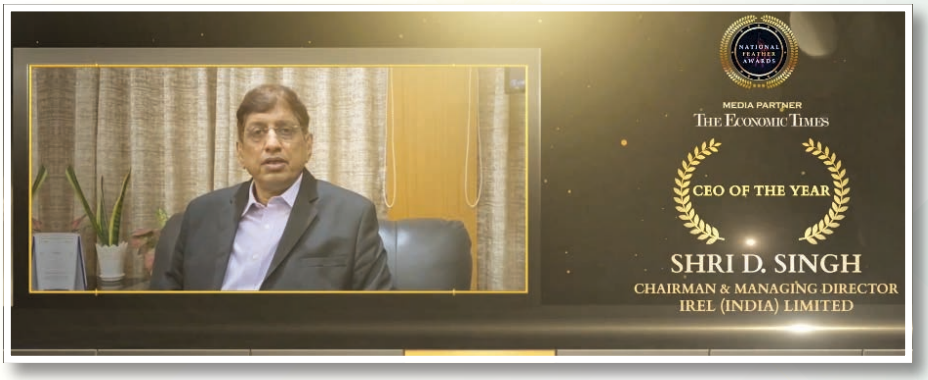
At last, efforts truly started paying dividend. During this period, IREL managed to secure long pending environmental clearance and CRZ clearance for existing operations of MK, expansion in capacity of OSCOM including mining areas in Chavara.

Increased Turnover

Finally, there seemed to be a ray of light at the end of the tunnel, in a manner of speaking and there was a gradual improvement in the sales turnover on a Y-on-Y basis. IREL surpassed its turnover of Rs. 1038 crores in 2019-20, as stipulated in the strategic plan by registering a mammoth threefold increase.

Overcoming operational issues, the reduced output from the southern mines was compensated by increasing the output of OSCOM. This helped in improving the topline of the company which resulted in enhanced profits. As such profits are essential for fuelling the future growth of company and the RE sector since equity infusion cannot be expected from the Government in the changed circumstances.

Awards and Accolades won by Shri D. Singh, CMD, IREL



CEO of the Year Award during National Feather Award Ceremony conducted by The Economic Times as Media Partner

CEO with HR Orientation, a tribute from CIMA

SCOPE award for excellent contribution to CPSE – Director (Technical) receiving the award on behalf of CMD, IREL

International Leadership Innovation Excellence Award 2019 by Institute of Economic Studies during "Indo-Sri Lanka Economic Co-operation" at Colombo - Shri A.Mishra, DGM (TS) receiving award on his behalf.

Awards and Accolades won by IREL

CMD, IREL Shri D. Singh receiving the SCOPE award for "Crisis Handling" from Shri Rajyavardhan Singh Rathore, Hon'ble Minister for State.

FIEO Export Excellence Award for Outstanding Export Performance in the category of Two Star Export House 2016-17 from Shri Nitin Gadkari, Hon'ble Union Minister for Road Transport & Highway, MSME in the presence of Shri Suresh Prabhu, Hon'ble Union Minister of Civil Aviation, Commerce & Industry -Award received by CMD & Director (Marketing), IREL

India's Best Company of the Year Award 2018 by Berkshire Media Pvt. Ltd – Award received by Director (Marketing) and GM (L & ER), IREL

The National Best Employer Brands Award 2018 by the Global Employer Branding Institute – Award received by CMD & Director (Technical), IREL

ICC Corporate Governance & Sustainability Vision Award 2020 by Dr. Bhaskar Chatterjee former Secretary, DPE in presence of Dr. V. K. Saraswat, Hon'ble Member of NITI Aayog, Govt of India

GreenTech Safety Award – Award received by GM & Head, RED and DGM, I/c, IRERC

Visits by Parliamentary Committee

Parliamentary Committee visit, 2019

Hon'ble M.P, Rajya Sabha Dr Satyanarayan Jatiya during visit of Parliamentary Committee to Kochi, 2017

Study visit of the Committee on Public Undertakings, 2016

Felicitation of Dr. C P Thakur, Hon'ble Chairman Parliamentary Committee by CMD, 2016

Rare Earth Aspects

Monazite Processing Plant had been operationalized by gradual ramping up the capacity utilization. An agreement was signed with M/s Toyotsu Rare Earths India Limited, an Indian subsidiary of Toyota Tusho Corporation, Japan post cabinet approval culminating from G-to-G understanding between the respective Governments. The agreement helped in understanding and improving the qualitative aspects of Rare Earth Chloride which are acceptable on an international level. This factor was especially important since a number of Chinese companies were now operational in this field with improved and next level technology.

Visit of Dr. Sekhar Basu, Chairman, AEC to RE Extraction plant, OSCOM

Launching of Souvinier during IC-STAR Seminar in Tirupati

Ex-Chairman, AEC Dr. S.Banarjee, visiting Exhibition on the occasion of STAR-2019

CMD with His Excellency Governor of Odisha, Shri Ganeshi Lal during Inaugural Session of CSIR Foundation Day at IIMT

The Rare Earth Division (RED), Aluva was dedicated to production of High Pure Rare Earths for refining of REEs. The initial hiccups pertaining to set up due to space and capacity constraints were resolved and the operation was set up and purity levels achieved.

The pilot plants for Dysprosium (Dy) and Gadolinium (Gd) were also established and dedicated to the nation with the expertise of BARC.

Shri K.N.Vyas, Chairman, AEC virtually inaugurating the Dysprosium Oxide facility of IREL in RED, Aluva

Value Addition Initiatives

During this time, concerted efforts were made in the value addition side by forming an SPV to set up the Sm-Co magnet plant at Vizag based on technology developed by BARC/DMRL. It took about two years to obtain statutory clearances from MoEF and CC and consent to establish; thereafter the work was started and it is currently progressing on schedule.

Signing of MoU's/ Agreements by IREL

BARC for developing technology in value chain of RE in presence of Shri K.N.Vyas, Chairman, AEC

TTC, Japan and TREI, India for supply of RE values

NFC for supply of Zircon

DRDO & DMRL for Sm-Co magnets

Another initiative in terms of RE value chain was an understanding entered with BARC towards development of various technologies based on RE. The work has been commenced on a RE theme park focused on housing scaled up plants for RE metal/recycling based on BARC technology and developing skill including quality consciousness to create trained manpower for developing future entrepreneurs for the industry. Both these initiatives are done with the financial assistance of DAE.

In addition, an initiative towards the setting up of a High Pure Titania & Zirconia plant at pilot level based on in-house technology development and financial assistance of DAE has also been taken up. The environment clearance was obtained and accordingly the work has been initiated. IREL has also initiated efforts and signed a MoU with the approval of Govt. of India for setting up a titanium slag plant in collaboration with and off take arrangement with M/s UKTMP JSC, Kazakhstan. A proposal for forming a subsidiary of IREL as a holding company for overseas acquisition of mines is also initiated which is awaiting nod of CCS.

Signing of MoU with UKTMP JSC, Kazakhstan for setting up Titanium Slag plant in Odisha

Formation of subsidiary – signing of Joint Venture Agreement between IREL & IDCOL in the presence of Shri Niranjan Pujari, Hon'ble Industries Minister, Govt. of Odisha

IREL is contemplating to take forward the vision 2032 of DAE by multifold increase in operations at each stage towards self-reliance of India especially in areas of e-mobility and energy security from non-fossil fuel sources, which envisages multifold capacity.

In order to improve its footprint, harnessing of the Hrushikulya-Bajrakot Brahmapur Deposit (BSM), Odisha has been initiated by forming a Joint Venture Company with Industrial Development Corporation of Odisha Limited (IDCOL), Odisha. IREL intends to obtain license for 2542 ha deposit and would be getting the license shortly as per the provisions under AMCR 2016.

Visits of IREL Delegation

TTC, Japan

AVISMA Plant, Russia

Salar de Uyuni, Bolivia under the leadership of Dr. V. K. Saraswat, Hon'ble Member, NITI Aayog

Shri Rishad Bathiudeen, Hon'ble Minister of Industries & Commerce,
Government of Sri Lanka and Officials from Indian Embassy, Colombo

Automated Operations of Weighbridge in OSCOM inaugurated by Dr. A.K.Mohanty, Director, BARC

International Conference

Addressing delegates of International Conference on TiO2 feedstock at Berlin through Video Conferencing, Sep 2019

Presentation during "Thorium Energy Conference 2018" at Brussels, Belgium

Presentation on "New Mining Policies" at TZMI Congress 2017, Hongkong

Presenting a technical paper on Rare Earths in Argus Rare Earths Conference 2016 at Hangzhou, China

Further, applications have been filed in other areas such as Bramhagiri Mineral Sands Deposit, Odisha; Inayam-Midalam Deposit, Tamil Nadu; Kudiraimozhi Deposit in Tamil Nadu; Donkuru-Boruva and Boruva-Bendi Deposits in Andhra Pradesh for notification of prospective lessee as per the provisions of AMCR. In addition, IREL is in the process of carrying out feasibility studies to harness the Ambadongar Deposit in Gujarat which is a hard rock deposit under exploration.

CMD, IREL visiting Ambadongar RE deposit, Gujarat

People Development

Working Environment

People matter and IREL has always been cognizant about this fact. While focusing on operations, there has always been a focus on employee development. During this period, the company could successfully manage revisions in pay for executives and two revisions of workmen, which seemed a distant possibility in 2015.

Health, Wellness and Safety, matters, in IREL

The company has also started wellness programme for each employee for predictive health improvement, skill upgradation, skill development and award initiatives for recognition of talent & innovative ideas. In order to develop fresh manpower for the industry, a scheme called 'IREL Connect & Inspire' with a view on future talent hunt has also been implemented.

International Yoga Day

Head, MK unit receiving National Safety Award (Mines) from Hon'ble President of India Shri Ram Nath Kovind in presence of Hon'ble Minister for Labour and Employment, Shri Bandaru Dattatreya, Govt. of India

Head, MK unit receiving National Safety Award (Mines) from Hon'ble Vice President of India Shri M.Venkaiah Naidu in presence of Hon'ble Minister MoS for Labour and Employment, Shri Santosh Kumar Gangwar, Govt. of India

A new start- Inaugural Function for first batch of New Trainees

CMD, IREL and other Dignitaries with second batch of Management Trainees
in Inaugural Session of Orientation Course at AMD, Hyderabad

Inauguration of Graduation Ceremony of Orientation Course for New Inductees in AMD, Hyderabad

The security features for retired employees have also been enhanced and a concept of service charter has been created for the betterment of employees on rolls. The working conditions along with hygienic environment and development of green belt and water conservation initiatives also find its due place.

Visit of Dr. Sekhar Basu, Chairman, AEC to Corporate Office, Mumbai

Shri Vinayak Apte, IG, DAE during the Hindi Pakhwada event in 2017

Celebration of Hindi Pakwada-2019

Women's Day Celebration in IREL

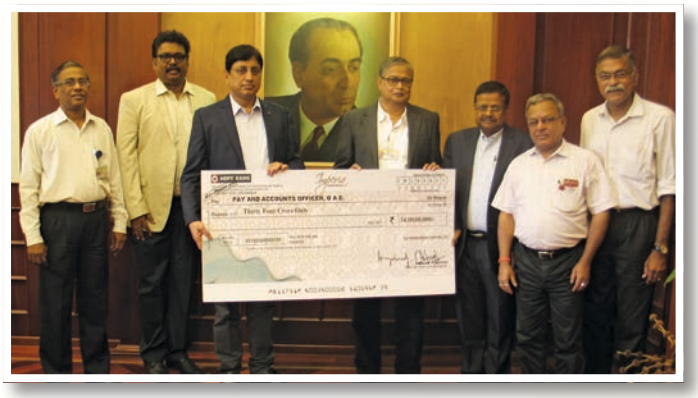
Shri K. N. Vyas, Chairman, AEC launching the new Logo of IREL

Net Impact

During the second phase of the decade post 2015, the profit of the company increased year after year on account of improved operational efficiency and volume of production coupled with reduction of operational and administrative expenses. During FY 2020 profit crossed Rs 400 Crores, which was in itself a new benchmark.

Increased profits helped the company to enhance the operational environment & wellness for the employees, enhanced dividend to Government of India and has built reserves for fuelling the envisaged planned growth. This resulted in initiation of more than three projects at a time.

During this period, the total revenue earned by the company increased to Rs. 1038.74 crore in the year 2019-20, while the share capital infusion remained same at Rs. 86.37 crore. IREL, in the year 2020-21, issued 100% equity bonus shares amounting to Rs. 86.37 Crore.



Dividend payment to Dr. Sekhar Basu, Chairman, AEC for the year 2017-18

IREL, virtually handing over the dividend cheque to Shri K. N. Vyas, Chairman, AEC

THE HOPEFUL FUTURE

The truth is somewhere in between

The Indian Dilemma in Rare Earth Sector

It is but natural to have this question in mind as to why India is not among the top producers in the Rare Earth sector like China at a global level. China could do this by developing the mining & refining segment as well as a comprehensive end to end value chain development. In contrast, India is only among the early starters having reportedly large resources of Rare Earth Element (REE). Since the name IREL itself encompasses Rare Earths; a quick reflection is directed to CPSE on this issue or even more specifically why isn't IREL accomplishing something in this regard? An analysis of this question is critical from a macro perspective and definitely needs to be dwelled upon.

A number of factors need to be taken into consideration when we ponder over this question and we shall examine this dilemma from the lens of process, product, policy, mineral assay, elemental composition, geopolitical scenario, driving industry, gestation period, etc.

Mineral Assay Factor

To start with the mineral assay, it is worth to mention that Monazite, the source material for REE occurs as a suite of seven minerals in the form of BSM sand (ore). The content of Monazite in this ore ranges from 0.06-0.15%. The content of Rare Earths in Monazite is 58%, which works out to about 0.035- 0.087% in the mineable sand (ore). In contrast, the Chinese source contains an average of more than 6% of REE in the ore, moreso, it is asssociated with iron, gold and silver, making mining all the more attractive. Thus, extraction of REE from Indian source Monazite is complex, long drawn, expensive and has a multi-stage concentration process before even reaching to the final stage of refining. In addition, the source of REE being radioactive in nature, poses additional challenges in terms of disposal of radioactive waste and environmental sustainability.

Another important issue is that the elemental composition in extracted RE concentrate from Monazite, which primarily contains five elements called Light REE (LREE) out of 17 elements and do not contain majority of Heavy REE (HREE), which are mostly important REE for strategic sectors. China has both type of deposits and therefore could command a dominant position in the sector. On the other hand, Indian deposits have a major portion of REE (about more than 2/3rd) as Cerium and Lanthanum, which are otherwise abundantly available in earth crust and are of least economic value among REE. Among LREE, it has been seen that only Neodymium and Praseodymium, have gained importance off late since the beginning of the 21st century due to their usage in high power permanent magnets. It clearly indicates as to why the RE industry did not grow in India prior to the development of magnet. Besides, in the first decade of the 21st century, the sector had been struggling with environmental & radioactivity issues coupled with economic viability, hence the operating plants stopped operations and were engaged in other important production activities. It was only post 2010, when China implemented quota system

for export of REE, that the activity restarted and now about 5000-6000 tons of RE concentrate is produced in India.

It is a well-known fact that REE being a performance enhancing material and not as core or structural material finds applications in multiple industrial segments and sectors ultimately contributing to a nation's economy, safety and security. These sectors include defense, space, energy, etc. and therefore Rare Earths are considered a strategic material. The rate of consumption of REEs in such industries and products is miniscule, which is evident from the global consumption pattern in terms of few hundred thousand and that too rendering elements like Cerium and Lanthanum (about 65% of Total Rare Earth Oxide (TREO) global production) as surplus. Due to the unique nature of these materials, low global consumption, complex & large value chain, there is a higher dependence on the core sector for development. It is also a material that has an international footprint and hence the REE sector may not be sustainable on its own, thus bringing about a need to develop a national strategy to extract, use and trade these elements.

At a very fundamental level, in a category like this, even more than others, policy matters dictate growth and also impacts future potential. This category has been subject to policy changes at frequent intervals over the last many decades and its development as a sector has seen consequent fluctuations. There needs to be more consistency and continuity in this matter.

Long Gestation Periods

There is a very long drawn process of supply chain v/s value chain starting from exploration to license for mining, separation of radioactive mineral & extraction of RE concentrate and refining having multistage operations; followed by metal extraction & alloy and product unlike other metals. All these stages require long gestation periods coupled with a need of partnering the segments in inter-disciplinary field to make a useful product. This clearly means that a long drawn vision with an expanse of 10 to 30 years time horizon is needed with continuity in order to generate momentum in the sector. It is a sector, which would never give instant returns and needs investment in terms of man and machinery and also loads of patience to see the proverbial gold at the end of the rainbow. Historical data demonstrates the time tested requirement of long gestation periods. We know that the RE product had excellent demand between 1970-80, which had been impacted with the entry of Chinese in the market in 1979 onwards. In fact, the efforts that China invested in 1979-80 has in fact started giving them rewards 2005-06 onwards.

Role of the Private Sector

In India, a major source of REE is Monazite which is a prescribed substance containing U and Th meant for the atomic energy programme in the country. The prima-facie mandate of IREL has

been to extract such radioactive elements (U & Th) for appropriate use in DAE and provide REEs in liberated (from radioactivity) and marketable form to industry for commercial applications. REEs are therefore kept under the open category free from license regime or any restriction. It has been expected as in any other commercial product that the private sector would play a significant role thereafter for manufacturing of products. However, this did not manifest in reality which may be due to certain inherent economic constraints.

The private sector did not find the sector interesting in the downstream, due to low profits, consumption in selective global pockets, lack of a domestic market, a long gestation period, non-availability of industry scalable technology and lack of instant returns. The private sector was naturally drawn to the mining side of minerals business which had adequate availability of technology and skilled manpower which meant immediate commercial gains.

It is also essential to differentiate between BSM and REE, which are spoken as synonyms but are in fact distinctly apart. Monazite, a radioactive prescribed substance is found in BSM sand, while REE are produced by chemical cracking of Monazite.

Monazite, the source mineral of REE in India occurs in fractional percentage in the BSM sand ore. Within the mineral, availability of REE is in the form of host of elements like Cerium-Ce, Lanthanum-La, Neodymium- Nd, Praseodymium- Pr and Samarium-Sm. These are commonly known as LREE. Out of them about 67% of REE is Ce & La, which are not so critical. The tonnage expressed as resource do not take into account the usability of elements, geology, grain size, recovery & purity and many other factors, which are in fact as important for putting to use the elements.

We saw an origin of this sector as early as when India attained independence. The primary need however then was to cater to the requirements of the atomic energy programme. After independence, building the industry and infrastructure sector started from the second five-year plan with a clear focus on the core sector. More so, in comparison to technological excellence for which REEs are known; basic amenities became the priority. Needless to mention that priorities are built based on the need of the society at large which meant a low focus was given to this niche sector.

Industry Dynamics

Another pertinent point worth noting can also be derived from the annual reports of the CPSE. This sector was started with the intent of processing of Monazite and Rare Earths happened to be a co-product. In those days (and it continues even today), there was hardly any industry in India which had a requirement of Rare Earth. Moreover, this material was finding applications only in Europe mainly in the catalyst and defense sectors. Incidentally both these sectors were absent in India. The desire for increasing the processing capacity of Monazite for obvious need

of the country necessitated acquisition of BSM deposits/ operating mines by the Government and also established the need for a marketing directorate in IREL to find the market for REE.

Although the downstream value addition industry remained open to the private sector, the private sector did not take active interest due to lack of profits and non-availability of industry scale technology. Besides being an intermediate product in the value chain, the existence of a 'driving industry' in the country is one of the essential requisite. As an example, the automotive industry came to India in mid 80's, and EVs drew attention in the mid of the second decade of 21st century on account of greener norms, which required strong permanent magnets, hence the need for this sector was felt much later.

All of this has definitely been a huge dilemma and a tight-rope balancing act.

In spite of all the above factors, India is known for having complex processing technology for Rare Earths, however India does not have a comprehensive end to end value chain of REE beyond oxides like China. As such capabilities of India may not be available in public domain as like any other country owing to radioactive resources of REE. Such a situation creates a perception in the minds of people that despite having reasonable resources in the country, India does not have a place in the global Rare Earth industry eco system as of today, which is far from the truth.

Transformation Factor

Over the years, India's efforts have grown noticeably far beyond the prevailing perception of being engaged in purely mining efforts supplying low value material to setting up facilities that can produce high purity REE. These changes span the decades ranging from 1950 to 2004. The setting up of the PRYNCE and HERO plants by IREL way back demonstrated the endeavors of India to move forward in value chain of REE. However, the fact of the matter was that there were hardly any commercial applications available in the country and therefore commercial production was not tenable.

Backward integration in terms of components and various input materials is one of the globally available methods of developing an end to end value chain ensuring availability of supply.

Global Benchmarking

If we look at the international scenario, in most cases, the facilities for value side marketable product gets established first and then as an exercise of supply chain development, upstream facilities are developed for supply security. This could be emulated in Rare Earths, Lithium and other critical elements. Thus, backward integration is the normal growth story for any sector for smooth transition as opposed to starting from the upstream side and then developing the entire value chain.

The World Order Today

This was in fact witnessed in the global trading eco-system post World War 2. There was a kind of international supply chain established, wherein countries having appreciable resources were developed as mining hubs while few others were developed as transitional hubs for intermediate products meant for strategic use or commercial end products. In such a world order, commercially and strategically important end products including products for use in defense manufacturing facility were developed in USA or the EU. Presumably, the present combination of 'QUAD' has a similar function.

In the world order created post World War 2, Australia, South Africa, Latin American countries, Japan, EU and USA were working as international trade partners completing the supply chain.

China positioned itself as a viable alternative especially in times of emerging chatter around emissions and environmental concerns. Slowly and steadily, it also started participating via upstream products and relaxing the environmental norms and thus managed to consolidate its position strongly. In many instances, the ores were transported to China, and they were processed, and sent back after extracting into elements. In the next few decades, China did develop a complete value chain and today they are posing a challenge to the alternative international supply chain and have almost emerged as a single source supplier.

The initial entry of China especially in the RE sector has been in the upstream side of things as a supplier of low value raw materials. With sustained efforts through a national plan, China could create economies of scale and also ascertain a clear monopoly by establishing an alternative model of end-to-end value chain posing a challenge to an erstwhile already established international trade model.

India needs to follow either of the afore-stated two models or develop its own tailor-made methodology to carve out its unique position on the global map.

Issues of Patent

The Chinese Rare Earth industry achieved a distinct position with the evolution of NdFeB magnet in the beginning of the 21st century. It is evident that, with the exception of China, countries that have REE as raw materials either do not produce them or are not major contenders in the industry. This disparity is a result of the complex patent web surrounding the invention of bonded and sintered NdFeB magnets. With numerous patents and disputes on patents over the composition and production process of NdFeB, the development of new technology and the entry of new players is indeed a challenge.

For instance, two separate inventions were created, bonded and sintered NdFeB magnets with the former patent lying with USA and the latter with Japan. Japan held a strong position in the industry and licensed out its technology to China which started the development of NdFeB magnets as well. However, soon, some Chinese companies began challenging the patents held by Hitachi Metals (the successor of Sumitomo Special Metals). This is only one such instance of a series of back and forth law suits over patent infringement and market manipulation amongst a series of accusation and claims.

China's Success Road Map

China's strong position in the Rare Earth industry can be attributed to an early development of their national strategy for Rare Earth production. China has supported the policy of developing downstream industries along the RE supply chain resulting in a high domestic demand for mined and extracted Rare Earths. The domestic demand for the RE has historically been greater in China than in the rest of the world and even higher than what is mined and extracted in China, creating both a strong internal demand and indirectly an alternative economic strategy.

The Chinese strategy is derived from China's red-carpet welcome to international manufacturing industry giants holding patents by offering relaxed environmental norms, single window clearance reducing the gestation period, cheap manpower with disciplined work culture and low power tariffs. Foreign companies facing strict environment norms for compliance in the developed world were encouraged to invest in downstream Rare Earth industry in China by shifting RE ore for further processing. All in all, such policies encouraged companies to move their production facilities to China and ended in an unintended transfer of technology to the local partner, since foreign companies were not allowed to take up any activity pertaining to Rare Earths without a domestic partner.

Although China has a large production capacity for NdFeB and exported 29,907 tonnes of the alloy as of 2017, it also imported 2,357 tonnes of the alloy in the same year. The disparity between export and import prices highlights China's dependence on Japan for the supply of high-grade NdFeB for industries that require the use of permanent magnets in elevated temperatures and/or strong demagnetization fields.

China's approach includes establishing joint ventures and other deals with overseas acquisition of Rare Earth resources in Africa, Latin America and Asia.

Epilogue – What Next for India ?

Actions speak louder than words

As of 2017, China has 36.6% of world resources, followed by Vietnam which has 18.3% of resources while India holds about 6% of the world's Rare Earth reserves. India produces about 2% of the total Rare Earth Oxide globally.

This disparity develops a perception of underutilization of resources. However, while making such comparisons, what is often grossly ignored is that Indian resources are locked with radioactive elements, are subjected to current status of mineable resource assessment due to large scale mining by private players, sterilization of resources occur due to inhabitation & tourism projects, Forest & CRZ exclusivity of area and finally there are constraints of generating radioactive waste & leach residue. It is often expressed that, merely selling the oxides might not be the best strategy across all the REE. But where is the driving sector? Obviously it is not a part of the RE sector.

Today, it is being said that when China can do it, why can't India not do it too? Since it is a long value chain, what is needed with paramount importance is a long term vision, an end to end policy framework and incentivization to the private sector in order to encourage them to set up industry in the downstream value addition sector. The public and private sector should not be projected as competing, rather complementary. The present encouragement by the Government towards self-reliance should be directed towards the downstream side. Alternatively, under the pretext of complexity of opportunity everyone would try to enter this segment, where technology and skilled manpower already exists with profit maximization motives.

The question we should be all asking is how rather than when. It is a step wise process and the need is to begin, consolidate and leverage the available resources and technical capabilities that inherently exist in the country.

In Conclusion

Jeff Bezos, Amazon founder had once said, "In today's era of volatility, there is no other way but to re-invent. And that is truly the only sustainable advantage one can have over others is agility. That's it."

Of course in a legacy company that too in a complex category governed by regulations, this is not as easy as it looks. There is a need to not just transform the business but sometimes the very ecosystem and the people too. All stakeholders have to own it and there is a need to engage, embrace and adopt newer ways of working.

Looking back, we at IREL have made huge strides and have come a long way since that accidental discovery in the early 1900's. We have tumbled and fallen down, picked the pieces and have learnt a lesson or two in this journey.

Failure isn't a bad thing — accept it, learn from it, and move on from it. Always think out of the box. Have the conviction to implement tough and unpopular solutions that have long term-benefits. Participate in nation building. Adapt and adopt to newer ways of doing the same thing.

After all Charles Darwin was right when he said, "It is not the strongest of the species that survives, nor the most intelligent that survives. It is the one that is the most adaptable to change."

And on this note, we look forward to another glorious 70 plus years of existing, growing and thriving in the new normal.

Do You Know These Facts about Indian BSM and Rare Earth Sector?

Sr. No.	Narrative	Facts
1	Large reserves of BSM is available in the country.	Mineable reserves are limited due to CRZ regulations, Mangroves, Forest and uncontrolled inhabitation. In addition, mining of these resources is carried out since almost a century. Thus, historical status of reserves needs to be revisited.
2	Large reserves of Monazite is available in India.	The average grade of Monazite in the country is about 0.10% in BSM Ore. Besides there is limited mineability due to inhabitation, forest and coastal regulatory zones. Extraction is subjected to grain size, geology, dispersion of deposit and concentration required to have a meaningful deliverable.
3	REE resources are abundant in the country.	Monazite is the primary source for REE in the country. From moderate grade BSM deposits, one needs to mine about 24000 tons of BSM ore to extract one ton of Nd, an important element for magnet. High volume and unregulated mining for too high tonnage of Nd will have to bear huge environmental case load implications. This should not outweigh the advantage of e-mobility towards the environment.
4	REE extraction is a simple process.	REE extraction is a complex and expensive process requiring high level of skills. The issue of economy of scale adds to further complication. REE resources are available in many countries but only a few (3 to 4) have processing facility on account of such reasons.
5	REEs are low value raw material (value addition).	As per globally acclaimed views, in the value chain from mine to magnet; highest value addition takes place in REE extraction from ore and its refining.
6	REEs are basic raw material for various RE based value added products.	REEs are the material added to functional material for providing catalytic improvement of their performance, which is manifested by its content varying from 0.5 % to 6.0 % in majority of cases and as high as 27 % in limited products. Due to this reason, the global consumption of REE is only in few hundred thousand tonnes.
7	Availability of REE resources is the key requirement for manufacturing REE based value added product i.e. magnet, catalyst etc.	Manufacturing of value added products having REE as one of the ingredients is done through interdisciplinary science and engineering, therefore all such value chain is long and complex. A number of intermediate industries are required to convert ore to end-product operating in different segments viz mining, processing & refining; metal & alloy and magnet manufacturing; BLDC motors and OEMs getting such products from their vendors under strict technical specification. These industries need to be connected in a chain link, ecosystem wherein absence of any link will make the whole system paralyzed.

Sr. No.	Narrative	Facts
8	Downstream value added industry could not be established since the sector was under Govt control.	Downstream industry using REE, Ilmenite or any other mineral product of BSM sector have remained open for all including private sector. The Ore of all such products are radioactive in nature due to presence of U & Th, therefore the processes requiring for handling of these radioactive elements or prescribed substance containing them or mixture of minerals with such substance are under the control of Govt. The Govt or PSUs extract the radioactivity in terms of U & Th for strategic applications and Ilmenite etc. mineral products & REEs free from radioactivity is provided to industry; thus reducing the burden of liberation of radioactivity to the industry. About 2200 industries are operating in the sector using Ilmenite, Rutile, Zircon, Sillimanite and REEs in the country manifesting that the material is adequately available to all. The presence of Government PSUs ensured technology and skill development in the sector.
9	Downstream RE industry is not established by private players due to non-availability of raw material.	Abundant raw material in terms of RE is available in IREL warehouses, there is no taker. Recently concluded exercise of identification of industry partner for Magnet making does not ensure immediate consumption, since setting up of unit will take few years with policy intervention.
10	Blessed with abundant resources, Mining volume need to be increased.	Due to limited global consumption unlike other bulk minerals, unregulated increase in mining would have unfavorable implications on supply-demand balance leading to supply surplus situation besides environmental concerns.
11	RE products find application in wind energy generation. Hence RE production to be increased for increasing renewable energy generation.	Production of RE is associated with environmental case load. It may need a tight rope balance between generation of renewable energy and REE production, so that generation of renewable energy should not be outweighed by excessive environmental case load due to Rare Earth production.
12	Resources are open to all elsewhere in the world.	Resources declared as strategic are normally under Government control elsewhere globally. India being non-signatory of NPT has its own obligations to safety and security of radioactive resources.

Sr. No.	Narrative	Facts
13	Having REE resources, India did not develop its REE portfolio.	India is among 2-3 countries, which has developed its REE portfolio other than China; though REE resources are available in many other countries. Before entering into interdisciplinary area, REO and RE metals are almost at the end of RE value chain. Out of them REO have better marketability due to inherent nature of this sector and India is in global map having capability to provide REO.
14	REE are critical and scarce	REE consists of 17 elements and all of them are not critical. In fact Neodymium (Nd), Praseodymium (Pr), Terbium (Tb), Dysprosium (Dy) and few HREE are the scarce & critical materials, while Lanthanum (La) and Cerium (Ce) are abundantly available in earth crust and are not critical or scarce.
15	To meet magnet requirement Nd production need to be increased multifold.	Due to composition of element specific content in RE minerals, Nd production is associated with more than 3 times the volume of Cerium and Lanthanum. On account of limited consumption of these elements, they create impediments in production of Nd. Enhancement of Nd production would need continuous and consistent evacuation of Ce and La.
16	Dependence of India on China for REE	In India, Rare Earths are produced in surplus than domestic demand. Indian deposits have only LREE, which includes Ce, La, Nd, Pr, and Sm.

Words from our Well-wishers

At IREL, we believe in the philosophy of the renowned American author, Seth Godin who said that leadership was about giving people a platform for spreading ideas that work. And this has really been exemplified in the conversations with our many well-wishers, mentors and people who have played an active role in the IREL journey so far.

When we spoke to them, there was pride in their hearts for their erstwhile organization and many of them graciously gave us inputs for the write-up.

We bring to you some of their encouraging words which are really the wind beneath our wings.

What is the message that you would like to give IREL?

"A unique culture of being conscientious of safety procedures and not put others into danger as they work with high-risk materials. IREL is more than competent to produce minerals; they should focus on value additions which can increase turnover manifold. They can truly be an inspiration for youngsters."

Shri M. S. Nagar,
Former CMD, IREL,
Sept. 1990 to April 1996

"I see a bright future for IREL- they have the right kind of thinking. They are setting up a theme park. I see a scope in synergistic combination of R&D knowledge base and commerce, trained personnel along with scale of operations."

Dr. T. K. Mukherjee,
Former CMD, IREL,
Aug 1996 to Mar 2005

"Indian Rare Earths Limited (IREL) is to me as precious as the Rare Earths are to the world. It was my good fortune to witness the growth of IREL at close quarters, even participating in my own way in its remarkable progress. Starting my professional career as a Junior Executive at IREL in May 1973 and rising to the helm as CMD, I was present and participating in all its progress over three and a half decades."

Shri S. Siva Subramanian,
Former CMD, IREL,
Apr 2005 to Jul 2009

"IREL is remarkable indeed – it has survived for so long inspite of so many challenges; it has not become a sick PSU unit. I would say, challenges will come and go. Continue to proliferate and prosper in the second half of the 21st century, while continuing to play a strategic role."

Dr. R. N. Patra,
Former CMD, IREL,
Dec 2009 to Nov 2015

IREL has a distinctive advantage of product diversity in terms of wider end use application, which provides it a large customer base in domestic and global marketplace. Over the period of its existence, IREL positioned itself meticulously by branding a corporate image through commitment in terms of quality & deliverables-thus providing value for money to the customers.

Shri V. K. Verma,
Former Director (Marketing),
Nov 1999 to Aug 2009

"I was associated with this organization for a brief stint as Director (F) & (HRM). I am proud to say that IREL has consistently kept employee interest in mind and providing matching employee benefits to the best in the Industry. Special mention is its policy on health security to its employees both existing and retired. This has come into sharp focus now as it has provided succor to so many, especially during the pandemic.

I wish and pray IREL (I) Ltd celebrates its centenary and many more centenaries in the future."

Shri S. Gopalkrishnan,

Former Director (Finance),

April 2005 to June 2013

"Continue with the current attitude of professional management, forward thinking and both horizontal and vertical integration which will ensure another century for the company."

Shri K. P. Sreenivasan,

Former CGM, MK,

March 2003 to Sept. 2006

IREL's Milestones