CHAPTER I

INTRODUCTION AND PROFILE OF THE NLC LTD.

INTRODUCTION

Job Satisfaction is a general look of workers’ positive attitudes built up towards their jobs. Positive attitudes of employees towards the whole business environment as a result their experiences of work-environment are called job satisfaction. Besides its answering the individual needs of physiology and security, person's feelings and values in positive way, then it can be said that there is a job satisfaction.

Job satisfaction has been a subject to logical researches with “Hawthorne” studies in 20th centuries. Job satisfaction is described as enjoyable or positive emotional state as a result of evaluation of the job or job experiences. Churchil, Ford and Walker (1974) describe the term of “job satisfaction” for salesmen as a state relating with being satisfied with the emotional devotion, conferment (rewarding), all attribute features constituting the job environment and the job itself. Job satisfaction is a concept which has a close relationship with motivation and activity. The main cause for that is the assumption that workers satisfied with their jobs are more productive, effective, and in a better move towards about their jobs compared with those who are not satisfied with their jobs.

Owing to this theory, job satisfaction studies are encouraged first in order to increase the effectiveness and productiveness of workers. These studies carried out with sponsorship of managers and enterprise owners. However, the thought that there is a positive association between job satisfaction and the productiveness of workers does not confirm by all scientific studies. For instance,
Bayfield and Crockett, in their studies, have proved that there is not an admirable correlation between the behaviours and attitudes of staff and their performances. Even though it can be said that there are some studies, which prove no relation between job satisfaction and productiveness of workers, generally, conditions in practice opposite that. Because the positive effect of satisfaction on motivation and effectiveness cannot be denied.

THE RELATIONSHIP OF JOB SATISFACTION AND ATTITUDES

Job satisfaction is a feeling that workers put on towards their jobs. Attitude is one of the important subjects focused on in social sciences. Attitude is the process of enthusiasm and recognition resulting from specific values and beliefs, in relation to one aspect of an individual's own world’s internal world. It is also possible to define attitude as the summation of sense, belief and thoughts which the individual forms in direction with his perceptions about his environment. In a sense, attitude is the stimulant of behaviour or the knowledge which prepares the individual for behaviour. Attitude, especially about senses, have importance because of the fact that they give continuity to the personality of individual, they give meaning to their daily activities and mentalities and that they facilitate his attempt made in order to gain various aims.

Attitudes are composed of three main elements. These are emotion, thought and behaviours. The element Emotion is related with the condition of individuals being optimistic, pessimistic or neutral towards things. The element of thought is composed of individual knowledge towards things. The element of Behaviour is related with action area, which is the outer appearance of knowledge and emotion elements. The most important feature of behaviours is that they generate with the interaction of biological, psychological and social elements of behaviours.
The elements of behaviours, as mentioned above, are studied by psychologists being reduced to three titles. However, with the effects of which factors, approaches, and behaviours related with this, come into being and according to which environmental stimulants they are shaped by, is a debatable subject. Bio-psycho-social system approaches asserted by Lipowski, Engel and Leih in recent years are the most important ones of these. According to Bio-Psycho-Social approaches, the primary base of various behaviours and approaches of human-beings is the common structure that biological, social, and psychological factors among which there is a functional relation and which form a system together constitute.

Some of the most important elements that create and effect attitudes according to Miner, called environmental factors, which are described as community, family, social groups, business organizations and other elements of previous and future. Environmental stimuli are the source of attitude items that consist of information, emotion and behaviour.

Attitudes are formed under the influence of environmental factors. Job satisfaction, as an attitude, is also formed under the influence of environmental factors. Environmental factors are family, religion, legal and moral rules and values, history, the prevailing mindset of the society in general, cultural elements etc. Because of that there is a close association of attitudes that accepted or rejected by employee with their socio-economic and socio-cultural personalities.

Defensive factors (hygiene). Preserving factors lead unsatisfactory conditions and contrary motivator elements lead fulfilment. The bad factors are: corporation policies and management, work condition, salary, status and relations with co-workers. The motivators are: success, fame, specialities of work, responsibility, awards and advancement.
There are many studies about job satisfaction. A few studies have proved that there is a direct connection between motivation, quality and job satisfaction, but some proved the contrary. Although some scientists such as Bray field and Crockett think negatively about this direct connection, most scientists believe this relation. Motivation of workers is about their fulfilment at work. All corporations should work on subjective studies about job satisfaction to retain their existing customers and attract potential ones. In regard of studies from past to this day, completely organized corporations are aware of this important process.

The success of any organisation depends upon its employees. In sustaining the market share, every organisation has a big responsibility of keeping its workforce satisfied. Employees’ of the day expect not a mere decent living but also a satisfied life. Personal satisfaction in the life of an employee depends upon what they get from job. A worker in stress cannot perform well in the job. The higher employee turnover and dissatisfaction in the job are the two serious competitive disadvantages faced by many of the modern day organisation. It is an undeniable fact that the future of any business venture depends upon the level of satisfaction of its workforce. Dissatisfied workforce causes immediate problem to their business. If the problems are left unattended they have a tendency of spiralling out to other business, or industry and even to other region. Hence in course of time it could become a serious risk to the growing economy.

Job satisfaction as a general attitude of the workers constituted by their approach towards the working conditions, wages, control, promotion related with the job, recognition of talent and some similar variables, social relations in the work, personal characteristics and group relations apart from the work life (Gruneberg 1979). At present, job satisfaction is a topic of considerable interest to employers since it is likely to influence the workers on their performance, and the organisation performance. Job satisfaction is key from the perspective of
maintaining and retaining the right employees within the organization; it is about fitting the right person to the right job in the right culture and keeping them satisfied (Glisson and Durick 1988).

THEORIES OF SATISFACTION

(1) NEED FULFILMENT THEORY

According to this theory a person is satisfied when he gets training from his Job what he wants. The more he wants something or the more important it is to him, the more satisfied he is when he received it. In other words, “Job Satisfaction will vary directly with the extent to which those needs of an individual which can be satisfied are actually satisfied. Vroom views satisfaction in terms of the positively valued outcomes that a job provides to a person. Thus, job satisfaction is positively related to the degree to which one’s needs are fulfilled. The fulfilment theory suffers from a major disadvantage. Satisfaction is a function of not only what a person receives but what he feels he should receive.

![Chart 1: Need Fulfilment Theory](image)
(2) EQUITY THEORY

Under this theory, it is believed that a person’s job satisfaction depends upon his perceived equity as determined by his input-output balance in comparison with the input-output balance of others. Every individual compares his rewards with those of a reference group. If he feels his rewards are equitable in comparison with others doing similar work, he feels satisfied. Job Satisfaction is thus a function of the degree to which job characteristics meet the desires of the reference group. For example, one study of the effects of community features on job satisfaction revealed that workers living in a well-to-do neighbourhood felt less satisfied than those living in poor neighbourhoods. Effects of community features on job satisfaction revealed that workers living in a well-to-do neighbourhood felt less satisfied than those living in poor neighbourhood.

(3) TWO FACTOR THEORY

Frederick Herzberg and his colleagues developed the two factor theory of satisfaction. According to this theory, satisfaction and dissatisfaction are interdependent of each other and exist on a separate continuum. One set of factors known as hygiene factors (company policy, administration, supervision, pay, working conditions, and interpersonal relations) act as dissatisfiers. Their absence cause dissatisfaction but their present does not result in positive satisfaction. The other set of factors known as satisfiers (achievements, advancement, recognition, work itself, and responsibility) lead to satisfaction. Several studies designed to test the two factor theory provide little support to this theory. The same factor may serve as a satisfier for one but a dissatisfier for another. It appears from this theory that person can be satisfied and dissatisfied at the same time.
(4) DISCREPANCY THEORY

According to this theory job satisfaction depends upon what a person actually receives from his job and what he expects to receive. When the reward actually received are less than the expected rewards it causes dissatisfaction. In the words of Locke, ‘Job satisfaction and dissatisfaction are function of perceive it is actually offering. In other words, satisfaction is the difference between what one actually received and what he feels he should receive. This theory fails to reveal whether over-satisfaction is or is not a dimension of dissatisfaction and if so, how does it dissatisfaction arising out of the situation of dissatisfaction and if so, how does it dissatisfaction arising out of the situations when received outcomes are less than the outcomes one feels he should receive.

5) EQUITY DISCREPANCY THEORY

This is a combination of equity and discrepancy theories. Lawler’s has adopted the difference approach of discrepancy theory rather than the ratio approach of equity theory. From equity theory the concept of comparison has been selected to serve as an intervening variable. Under this theory satisfaction is defined as the difference between the outcomes that one perceives he actually received and outcomes that one feels he should receive in comparison with others. When the individual feels that what he actually received is equal what he perceives he should receive there is satisfaction. Thus an individual’s reception of his reward is influenced by more than just the objective amount of that factor. Because of this psychological influence the same amount of reward after can be seen quite differently by two people, to one it can be a large amount, while to another person it can be a small amount.
(6) SOCIAL REFERENCE GROUP THEORY

Reference group defines the way an individual looks at the world. According to this theory job satisfaction occurs when the job meet the interest, desires and requirements of a person’s reference group. In other words, job satisfaction is a function of the degree to which the job meets the approval of the group to which the individual looks for guidance in evaluating the world and defining social reality. The social reference group theory is similar to the need fulfilment theory except that it takes into account not the desires. Needs and interest of the given individual but rather the point of view and the opinion of the groups to whom the individual looks for guidance.

THE ADVANCEMENT OF JOB SATISFACTION STUDIES

1. JOB SATISFACTION- CLASSICAL MANAGEMENT APPROACH

Job satisfaction studies first emerged when Taylor’s classical approach was criticized. Taylor had connected doing a work and increasing productivity directly to its own inside elements. For this reason he regarded the work’s own elements and work organization bun not the worker. According to Taylor, there is no special ability. All workers are the same. All processes can be analyzed step by step without requiring any talent and anybody who wants to learn this process can be a first class worker, the most difficult works can be learned by any worker.

Organization and management theories are at the top of the factors that encourage job satisfaction studies. These theories come from the organization structures in which workers do their jobs. At first, it was Taylor’s theory which leads these studies. But this secondary theory rather regards the performers, humans not works as Taylor does.
The classical approach which is a combination of Weber’s bureaucratic management approach and Taylor’s scientific approach regards workers as machine and economic beings. Workers are biologic (human) beings who are doing jobs to earn their needs (economic aims). According to this, what workers should do is to follow the instructions of managers carefully. So the rewards will come as money in the end. To earn more money, the worker will use his abilities wisely. The classical theory therefore is minimizing the human needs.

2. JOB SATISFACTION-NEOCLASSIC MANAGEMENT APPROACHES

As an alternative to classical theory, in this theory workers’ communication, their wish to join the management and effective communication are base elements. It is alleged that these are more effective in terms of productivity. Accordingly, the quality and content of social communication and fulfillment are important subjects.

Human interactions theory gives importance to interactions and belonging sense next to the economical behaviours of workers. A person is not only an economic being but he is also bearing respect for others, realizing himself, wishing to advance. For this theory humans behave in related with other humans’ behaviours. This is called social behaviour. Even an ordinary worker and the boss do the same. It is the human interactions theory which started job satisfaction studies. This theory gives importance to social factors. Especially light experiments carried out in Western Electric Corporation have proved that, humans’ relations are effective in productivity and communication.

Attitudes about job satisfaction are regarded first of all a subject of management and psychology. But later was understood that it is not only related with psychology. Social factors are as important as them. For example;
Yankelovich examined job satisfaction with gender, race, education, job, age and stated important results related with social factors.

**RELATIONSHIPS BETWEEN JOB SATISFACTION AND WORKPLACE FACTORS**

Workplace factors that affect job satisfaction also affect other job aspects such as work related stress. High levels of stress are associated with low levels of job satisfaction, and are also predictive of a greater propensity to leave the organization (Fairbrother and Warn, 2003). However, in this study of 100 naval officer trainees in the Royal Australian Navy, the researchers found that job satisfaction was influenced by factors separate from those that influence stress, although stress does affect job satisfaction (Fairbrother and Warn, 2003).

Other workplace factors that may impact job satisfaction are internal to the organization itself: its vision, culture, and communication style. Satisfaction with the organizational vision has been shown to affect overall job satisfaction, accounting for 33 per cent of the variance in job satisfaction. Organizational culture may influence satisfaction through the level of person-culture fit. If the values of the individual are different than those espoused by the organization, it is very likely that the individual will feel out of place and experience lower job satisfaction as a result (O’Reilly, Chatman, and Caldwell, Judge and Bretz). Communication within the organization impacts the “climate” of the firm, which is multidimensional in nature. As Muchinsky states, “the data suggest that one’s affective response to organizational communication is substantially related to the affective responses associated with other facets of an employee’s job” which includes job satisfaction and organizational commitment.
RELATIONSHIPS BETWEEN JOB SATISFACTION AND OTHER CONSTRUCTS

One of the most researched (and most disputed) relationships is between job satisfaction and organizational commitment. Organizational commitment is “the extent to which an employee identifies with and is involved in the organization”

Organizational commitment has historically been viewed as a more stable construct than job satisfaction (Curry et al., 1986; Bateman and Strasser, 1984). It is viewed as beginning to emerge as a “function of pre-entry experiences” (Bateman and Strasser, 1984, p. 107) which is then solidified upon organizational entry as a result of the level of cognitive dissonance experienced (Vandenberg and Lance, 1992). It may further develop as the employee develops “investments that bind to organization” (Meyer et al., 1990, p. 719). However, some studies have shown that job satisfaction was just as stable as organizational commitment when measured over time.

Historically, job satisfaction has been theorized as antecedent to organizational commitment (Vandenberg and Lance, 1992; Curry et al., 1986). Although this relationship has been popularized, organizational commitment has been found to be antecedent to job satisfaction in several studies (Bateman and Strasser, 1984; Vandenberg and Lance, 1992). Additionally, “no causal effects [have been found] in either direction … over time” (Curry et al., 1986, p. 851-852), although this theory was not supported by the research of Vandenberg and Lance (1992). It is also possible that the two constructs have a cyclical relationship, although this was not tested in the studies surveyed.

Other constructs studied in relation to job satisfaction are engagement and person organization fit. Engagement has been defined as “creating conditions for
meaningful employee expression in work roles” (Avery, McKay, and Wilson, 2007, p. 1542), and as commitment, which is “motivation on the part of employees to help the organization succeed”, in conjunction with line of sight, which is the “focus and direction that enables employees to understand what to do to make their organizations successful” (Watson Wyatt Worldwide, 2007, p. 3). Engagement has been demonstrated to be a predictor of turnover, customer satisfaction and loyalty, safety in the workplace, and, to some extent, productivity and profitability as well (Avery et al., 2007). It also has been shown to directly affect employee performance (Avery et al., 2007; Watson Wyatt Worldwide, 2007).

One aspect of job satisfaction that has been shown to be significantly related to engagement is satisfaction with one’s co-workers (Avery et al., 2007). This is important in regards to retention, as employees who are engaged are less likely to leave (Avery et al., 2007, Watson Wyatt Worldwide, 2007).

Person-organization fit is defined as “the degree to which individuals are suited to a job”, and “depends on their motives and need and the job’s requirements” (O’Reilly et al., 1991, p. 489). Values are also “an important determinant of person-organization fit” (Judge and Bretz, 1992, p. 269), as the congruency of the values of the individual to the work values within the organization is an essential component of what determines person-organization fit (Judge and Bretz, 1992). Organizational work values were shown to significantly impact job choice when information about them was known in a study of 67 professional and graduate students. This indicates that a person will be more likely to choose a job where he or she believes their values will fit well with the organization (Judge and Bretz, 1992). When the individual is considering entering the organization, they consider the salary, the opportunity for promotion, and the organizational value factors, but the effects of the
organizational value factors on job choice were stronger than the effects of the other two factors (Judge and Bretz, 1992).

Once the individual has entered the firm, person-organization fit continues to be an important determinant of on-the-job attitudes and behaviours. Job satisfaction can be predicted by person-organization fit, as can organizational commitment, performance, and turnover. The effects of person-organization fit on these constructs were found to occur independently of age, gender, or tenure (O’Reilly et al., 1991). Additionally, job satisfaction and organizational commitment were predicted a year after the initial measurement of fit, and actual turnover was predicted after two years (O’Reilly et al., 1991). This indicates that person-organization fit continues to impact the employee long after the initial ‘settling-in’ period is over. If the employee does not feel that they fit in, they tend to leave (O’Reilly et al., 1991; Wallach, 1983).

**RELATIONSHIPS BETWEEN JOB SATISFACTION AND PERSONAL CHARACTERISTICS**

Several personal characteristics, such as age, gender, and personality, have been reported to affect job satisfaction. They may affect it directly, as in the case of age (Oshagbemi, 2003), or they may affect it indirectly by affecting other factors that impact job satisfaction, such as stress (Fairbrother and Warn, 2003). Personality may also influence the initial job choice itself (Judge and Bretz, 1992).

As people progress through the career life stages, their job satisfaction is expected to increase (Westerman and Yamamura, 2007; Jepsen and Sheu, 2003). As the individual gains more work experience, they will be able to move closer to their ideal work situation and they will therefore attain more job satisfaction.
However, survey data does not always provide support for this progression. In a 25-year study of 169 high-school graduates, it was found that the average job satisfaction scores remained the same during the adult years, whereas the average job congruence (measured by the similarity between the individual’s major in college and the position held at the time of the survey) increased significantly (Jepsen and Sheu, 2003). Davis (2004) also found no evidence to support the hypothesis that older people tend to be more satisfied with their jobs than younger people, and no statistically significant generational differences have been found for job satisfaction in recent research (Macky, 2008).

Personality characteristics can affect the level of job satisfaction an individual is able to experience at work. As stated by Jepsen and Sheu (2003), some personalities are more likely to be satisfied regardless of their fit with their work” while “… some kinds of work produce job satisfaction irrespective of the extent of matching with personal characteristics” (p. 165). Research by Agho et al. (1992) identified two distinct personality variables-positive affectivity and negative.

**DETERMINANTS OF JOB SATISFACTION**

While some researchers have theorized about more or less specific work factors relevant to job satisfaction (Locke, 1976; Hackman, 1975) there is no “gold standard” that indicates which job aspects should be taken into account when job satisfaction is measured.

For the practitioner, knowledge of the determinants, the consequences and other correlates of job satisfaction can be vital. An understanding of factors involved in job satisfaction is necessary and relevant, on one hand in improving the well being and life of significant number of people and the enterprise on the
other. Organizations may reach competitive levels of quality, either at a product level or a customer service level, if their personnel feel satisfied or identify with the company. Many scientists and researchers involved with the recording of the factors affecting employee satisfaction. Some theorists have viewed job satisfaction as a bi-dimensional concept consisting of intrinsic and extrinsic satisfaction dimensions. Intrinsic sources of satisfaction depend on the individual characteristics of the person, such as the ability to use initiative, relations with supervisors, or the work that the person actually performs; these are symbolic or qualitative facets of the job. Extrinsic sources of satisfaction are situational and depend on the environment, such as pay, promotion, or job security; these are financial and other material rewards or advantages of a job.

Both extrinsic and intrinsic job facets should be represented, as equally as possible, in a composite measure of overall job satisfaction. It is observed that the level of job satisfaction is determined by four main groups of factors: economic aspects, interpersonal relations, working conditions and personal fulfilment, including:

(1) PAY

The amount and fairness or equity of salary is considered as a factor crucial for all matters relating to human labour. A salary is a payment which persuades an employee to commit his personal time and work. The problem of the salary is also a main source of cost for the operation and development of business (Oshagbemi, 2000). There is no clear view on the relations between job satisfaction and salary. Characteristic is the view of Herzberg who integrates the salary to the "hygiene factors". On the other hand, theorists such as Locke and Porter concluded that if the salary is equal to or greater than expected from the employee the employee’s satisfaction increase and the opposite result occurs when the salary is lower than expected.
(2) **WORKING HOURS**

According to several surveys the job satisfaction is affected by the existence of a conflict of roles of the employee. The role conflict occurs when at the same time requires the employee to perform two or more roles and success in one precludes success in another. A worker might sometimes be experiencing role conflict, which arises from the difficulty of bringing balance between professional demands and personal expectations. The conflict of roles associated with the discomfort of the work, share common causes. Examples of such causes are naughty working hours and frequent overtime. The role conflict and employee satisfaction are also because when a worker spends most of his time working, sacrificing the quality of life and involvement with friends and family factors that influence the employee’s satisfaction (Pors, 2003).

(3) **WORKING CONDITIONS**

This term refers to the work place where workers are performing their work. According to the researches the work environment should have three goals: excellence in organizational terms, meet the needs of customers and employees.

(4) **SUPERVISION** (fairness and competence at managerial tasks by one’s supervision) and co-workers (perceived competence and pleasantness of one’s colleagues). According to Cranny, Smith, Stone, (1992) creation the loyalty in the job helps people to learn to contribute and to feel freedom in their work. A similar view was expressed by Morrow and Reichers (Chen, 2001), who argued that the good relationships with co-workers is one of the most important factors affecting their employment behaviour and satisfaction.
(5) THE HUMAN RESOURCES DEPARTMENT

The role of human resources department is connected with the recruitment, selection, organizational design and development, business transformation and change management, performance, conduct and behaviour management, industrial and employee relations, human resources analysis and workforce personnel data management, compensation, rewards, and benefits management, training and development. These functions and values are directly related to employee satisfaction.

(6) JOB DESIGN

Many theorists believe that the characteristics of the job description affect job satisfaction. Such characteristics are autonomy, variety, encourage and reward employee initiative, recognition, appreciation, and other motivators, skill improvement opportunities and clarity of function (Abraham, Medoff, 1984; Abraham, Medoff 1985; Pors, 2003). As part of the job design should be also mentioned the risk of absence of clarity of tasks, which negatively affects job satisfaction.

(7) DEMOGRAPHIC CHARACTERISTICS

There have been numerous studies into job satisfaction which explore the impact of demographic characteristics such as age, gender, tenure, and education.

(8) STRESS

One of the major adverse influences on job satisfaction, work performance and productivity is the increasing incidence of stress at work. Stress is a source of tension and frustration. It is a complex and dynamic concept, and can arise
through a number of interrelated influences on behaviour including work, home and organisational issues. For example, the restructuring of organisations and lower staffing levels have placed greater pressures on the remaining staff resulting in a growing number of related health problems and work stress. However, the causes of stress are complex. Stress is also a very personal experience as is the response of each individual. It would probably be helpful to draw attention to the increasing debate on the work/life balance.

Manager’s concern for people
Job design (scope, depth, interest, perceived value)
Compensation (external and internal consistency)
Working condition
Social relationship
Perceived long-range opportunities
Perceived opportunities elsewhere
Level of aspiration and need achievement

Job Satisfaction/ Dissatisfaction

Commitment to organisation
Turnover, absenteeism, tardiness, accident, strike, grievance, sabotage

Chart 2: Determinants of Satisfaction and Dissatisfaction
THE IMPORTANCE OF JOB SATISFACTION STUDIES

In industry communities, most people spend most of their time at work area. Because, in these communities, the quality of social relations is shaped by the farm of production, consumption and sharing which are base of economical actions. People make up their mind and desire their decides according to these three elements. Social theories developed about industry communities, take production, consumption and sharing focus. In this study, it is focused on the production side of the employment-related part of industrial society. It is about the work satisfaction of workers. In industry community, the work life is very different from pre-industry. The field of work was organized in a new way which the works were not used to. A new field was born which is called work life. This triggered the birth of a new social group related to work and production.

That is management organization. Establishments are places where people spent most of their time in any way in modern communities. Work life is one of the most important topics in terms of social and individual action. Although subject has many sides as national, economy, development, social peace, syndicate….etc, for this work, the main important thing is satisfaction of people who spend most of their times in management organizations, the possibilities of economic actions, the planned work.

PROFILE OF NEYVELI LIGNITE CORPORATION LTD. (NLC)

Neyveli Lignite Corporation Ltd. (NLC) is India's largest lignite mining company, and is also one of the country's leading power generation companies. The company operates three open cast mines in Neyveli, in the state of Tamil Nadu at the south-eastern tip of India, producing some 24 million tons of high-grade lignite per year. Mine I, the company's original mine, is operated over an area of nearly 17 square kilometres and offers a reserve of nearly 300 million tons. Mine II, first tapped in early 1984 and expanded in the early 1990s,
features a reserve of nearly 400 million tons. The total reserves in the Neyveli field are estimated at more than two billion tons. Most of that production is used in NLC's two thermal power generation plants, which combine for a total capacity of 2,070 megawatts. After shutting down its fertilizer and briquette and carbonization plants in the early 2000s, NLC has begun a drive to expand its power generation capacity. In 2003, the company began construction of a green field power generation facility in Tuticorin, in Tamil Nadu, with a proposed capacity of as much as 1,000 megawatts. In 2004, the company received approval to expand beyond its home state, and is beginning preparations to build a 250 megawatt facility in Bikaner, near Rajasthan. NLC has also been tapped to restart the nearly 4,000-megawatt plant in Hirma, originally developed by a Mirant-Reliant partnership. Owned at 94 percent by the Indian government, NLC has as its primary customer the Tamil Nadu Electricity Board. In 2003 the company posted revenues of INR 2,681.48 crore ($601.1 million).

COMPANY PERSPECTIVES

Neyveli, home of the Neyveli Lignite Corporation, is India's energy-bridge to the 21st century and a fulfilment of Pandit Nehru's vision. Incidentally, Nehru and NLC share a common birthday (14.11.1956). Nehru launched the mining operations with his golden touch in May 1957. Ever since, there has been no looking back. NLC has achieved the objectives it has set for itself, fulfilling its corporate mission to be the leader in the industry.

POWERING THE ECONOMY IN THE 1950s

The vast Indian subcontinent had always offered an abundant supply of natural resources. Particular interest was placed on exploring for fossil fuel sources in what was later to become the Tamil Nadu region along the country's south-eastern tip. Among the first to be discovered were the peat fields in
Calimere, in 1828. The first lignite deposits, a still more valuable fuel source, were located along the coast region near Cannonade in 1830. This initial deposit was followed by the discovery of others in the region, at Beypore, Pondicherry, and elsewhere. French engineers began drilling bore holes in the French-dominated Bahoor, and succeeded in locating significant lignite deposits in Kasargod and in the region around Cuddalore, near Neyveli, in 1884.

Attention again focused on the region around Neyveli in the 1930s. Neyveli was then a small village in Tamil Nadu; its chief resources at the time were its cashew and jackfruit forests. The earliest discovery of exploitable lignite deposits in Neyveli was attributed to Jambulingam Mudaliyar, a prominent local landlord who controlled some 600 acres across Neyveli, Cuddalore, Mandarakuppam, and Virudhachalam. Farms covered only a small part of Mudaliyar's land. In the early 1930s, Mudaliyar began sinking well holes, searching for a source of water in order to transform more of his holdings into cultivatable land. Water proved easy to find--but brought with it pieces of a black substance that local workers called "black clay," which were thrown away. Yet, once dried by the sun, the "black clay" proved highly combustible.

Mudaliyar brought the existence of lignite to the attention of the British authorities, hoping to convince them to launch a lignite mining operation in Neyveli. Mudaliyar began drilling new bore holes in 1935, discovering large quantities of the substance. Samples were sent to the governor of Madras for testing, yet the British colonial government remained uninterested in pursuing the project. Instead, Madras-based Binny and Company began sinking bore wells in Aziz Nagar, near Neyveli, in 1941. That company succeeded in discovering a significant lignite deposit, but, lacking the equipment to pursue further drilling operations, the company withdrew.
The colonial government's Geological Survey of India at last began drilling in Neyveli in 1943. Over a three-year period, more than 30 bore wells were sunk, confirming the region's lignite potential. Following India's independence, the new government appointed H.K. Ghosh—who later earned the nickname "Lignite Ghosh"—to oversee further lignite exploration activities. Ghosh began sinking a new series of wells in 1947. Initial wells were abandoned, however, after they became blocked with water and sand. By 1948, Ghosh had discovered the first viable site, and succeeded in drawing out samples of lignite.

Ghosh revealed the ambitiousness of his project in 1949, when he drafted plans to establish a vast open-cut, mechanized mine covering an area of some 14 square kilometres. Ghosh began coordinating bids for the project that year. Preparations were made to drill a more extensive series of bore wells in the proposed area, and under Ghosh's direction, the drilling of 175 bore wells began in 1951. A second series of 150 wells was also launched that year, this time in Virudhachalam under the auspices of the Tamil Nadu government. Ghosh's efforts were crowned with success—by the end of the drilling project, Ghosh had revealed potential lignite reserves of some two billion tons.

Approval for a pilot quarry was granted in 1952. By 1953, Ghosh had succeeded in mining the first 100 tons of lignite. The development was all the more significant because of the high quality of the field's lignite, which had a relatively high moisture content compared to other lignite deposits. A visit by Indian President Nehru in 1954 brought government backing to the lignite mining project, and in 1955, the Tamil Nadu state government transferred oversight of the project to the central government.

Neyveli Lignite Corporation was created as a government-owned enterprise in 1956 in order to launch the full-scale exploitation of the lignite
NLC's mandate was to produce lignite, and to construct and operate a lignite-burning thermoelectric plant providing electrical power to the state of Tamil Nadu. Construction on Neyveli Mine I began in 1957, using technology and equipment brought in from Germany. The mine by then extended over an area of nearly 17 square kilometers, with an estimated reserve of 287 million tons. Mine I was constructed to produce a capacity of 6.5 million tons per year.

With an "overburden" varying from 70 to 95 meters, the Neyveli field's first lignite seam—with a thickness ranging from ten to 23 meters—was exposed only in 1961. Full-scale lignite mining was launched in 1962. That year saw the commissioning of the first stage of NLC's Thermal Plant Station I. Built with technology and assistance from the Soviet Union, TPS-1's initial capacity stood at just 50 megawatts. By the end of the decade, however, NLC had commissioned a total of six 50 megawatt units and three 100 megawatt units. All of NLC's power production was then taken up by the Tamil Nadu Electricity Board.

In the mid-1960s, however, NLC diverted some of its lignite production to fuel its extension into two new areas. The first was the launch of its Fertilizer Plant, producing urea, a by-product of its lignite mining operations. The second was a Briquetting and Carbonization Plant, established that same year to produce more than 3.25 million tons of charcoal and 2.6 million tons of coke per year. That plant also produced such by-products as carbolic acid, xylem, phenol, and neutral oils and other chemicals.

As India began its industrialization program in the 1970s, demand for electrical power rose steadily. By the late 1970s the decision was made to extend NLC's operations to include a second mine, which in turn provided support for a new thermal power station. The new mine, Mine II, was located some five
kilometers south of the original mine, on a 26 square kilometer site that exploited the same lignite seam. The total exploitable lignite deposits at the site were estimated at 398 million tons. Construction of the open pit mine, with an overburden reaching up to 103 meters and a lignite seam between eight and 22 meters in thickness, was launched in 1978. Mine II's initial production capacity was placed at 4.7 million tons per year.

Mine II's lignite seam was exposed by September 1984, and full-scale lignite production began in 1985. By then, NLC had already been granted authorization to increase the scale of the Mine II project to 10.7 million tons per year. The mine reached full capacity in 1991. Mine II's production fuelled NLC's Thermal Power Station II. Construction began on the new plant in 1978, with an initial capacity of 630 megawatts. With the increase in Mine II's production levels, TPS II's capacity was expanded as well, to 1,470 megawatts. The first 210-megawatt unit was commissioned in 1986, and the plant reached full capacity in 1993. Also in 1986, the Indian government converted NLC to a public company, selling shares to institutional investors as well as placing a small number of shares on the Bombay Stock Exchange. Nonetheless, the government's control of NLC remained at more than 94 percent.

**EMPHASIZING POWER GENERATION IN THE NEW CENTURY**

By that time the company had launched a Life Extension Project on TPS I, intended to extend the plant's viability by another 15 years. The project, launched in 1992, was completed in 1999. In the meantime, NLC had also been granted authorization to expand the capacity of the Mine I site, raising total annual production to 10.5 million tons. As part of that effort, the company also launched an extension of TPS-1 in 1996, adding an additional 420 megawatts to the plant's total capacity.
In 1998, the government authorized NLC to expand its lignite production yet again, with the construction of an extension to its original mine as a new site, Mine IA. Construction of the mine began in 2000, with production of lignite expected to begin by the mid-2000s. The company also began preparations for the expansion of Mine II and the proposed construction of a Mine III, launching an exploration and drilling operation in 1999.

Low demand for fertilizer products led the company to close its fertilizer plant in 2003. By then, NLC had already shut down its outdated Briquetting and Carbonization operations as well. Instead, NLC focused on expanding its power generation operations. In 2002, the company announced its intention to expand production of Mine II to 15 million tons per year in order to fuel the extension of its TPS-2 facility to nearly 2,000 megawatts. These projects were expected to be completed by 2006.

At the same time, NLC began plans to develop a new 250-megawatt power generation plant at Rajasthan, which was activated in 2002. That project was approved in 2004. The company also launched development of a new Greenfield site at Tuticorin. Initially planned for a capacity of 500 megawatts, in 2003 NLC announced its intention instead to build a 1,000 megawatt plant on the Tuticorin site. By 2003, NLC also appeared likely to revive a 2,000 megawatt plant in Orissa, part of the Hirma project initially developed by a partnership between Mirant and Reliant. In that year, the company also received an invitation from the Madhya Pradesh state government to construct and operate a 1,000-megawatt plant there, a tribute to NLC’s technological and operational expertise. With plans in place to increase its total power generation capacity to more than 6,000 watts by the end of the decade, NLC appeared to be redefining itself, from a lignite mining concern to one of India’s leading self-sufficient energy producers.
PRINCIPAL COMPETITORS

Fushun Coal Mine Bureau; RWE AG; Ping ding Shan Coal Group Company Ltd.
Rostovugol; American Electric Power Company Inc.; Kreka Coal Mine; Mono Bobov Dol AD; Coal India Ltd.

GROWTH OF NLC

1956 : Neyveli Lignite Corporation is established to exploit lignite deposits in Neyveli area in Tamil Nadu state in India.
1957 : Construction begins on Mine I and Thermal Power Station I (TPS 1).
1962 : Lignite mining operations begin; TPS I is commissioned.
1966 : Fertilizer Plant and Briquette and Carbonization Plant open.
1978 : Second lignite mine and thermal power station are launched.
1983 : Mine II begins operations.
1986 : TPS II is commissioned.
1996 : Mine II and TPS II are expanded.
2000 : Construction begins on Mine IA.
2002 : Mine II and TPS II expansions are completed; shutdown of Briquette and Carbonization Plant.
2003 : Shutdown of Fertilizer Plant; company begins development of new power plant at Rajasthan.
2004 : Company launches green field power plant at Tuticorin.
2005 : NL Centers into an MOU with Rural Electrification Corporation for funds to Rs.2500Cr
2006 : Shri S.P Seth, Additional Secretary to Govt.of India has been appointed as Ministry of Coal as a part-time Official Director on the Board of the Company in the place of Shri Pradeep Kumar
2007: Shri Y.N Appa Rao, Shri. Shashi Kumar, Dr. Krisha kumar, Shri. Ravindra Sharma, Shri. S Rammohan, Sri. P.K.Chouhury have been appointed as additional Directors of the Company

2009: Shri. R. Kandasamy as an Additional director of the company has been appointed as an additional Director

2010: Shri Sanjay Govind Dhane, has been appointed as an additional director on the Board of Director of the NLC

2011: 18 Billion Units of power generation in a year, NLC Power Stations creates new history

2012: NLC signs memorandum of Understanding for the JV with Uttar Pradesh Rajya viyut Utpaan Nigam Limited

2013: Declared final dividend@10% to share holders

2014: Declared final dividend@18% to share holders

2015: NLC inaugurated 10MW Solar Power Project at Neyveli

2016: The name of Neyveli Lignite Corporation Ltd. shall be changed to NLC India Ltd. and symbol be changed from NEYVELILIGTO NLCINDIA.

PERFORMANCE OF NLC POWER PROJECTS

NLC India has five pithead Thermal Power Stations with an aggregate capacity of 3240 MW. Further, NLC India has so far installed 29 Wind Turbine Generators of capacity 1.50 MW each and also commissioned 10 MW Solar Photo Voltaic Power plant in Neyveli, resulting in an overall power generating capacity of 3287.5 MW (excl. JVs).

THERMAL POWER STATION-I

The 600 MW Neyveli Thermal Power Station-I in which the first unit was synchronized in May’62 and the last unit in September’70 consists of six units of
50 MW each and three units of 100 MW each. The Power generated from Thermal Power Station-I after meeting NLC’s requirements am supplied to TANGEDCO, Tamil Nadu which is the sole beneficiary. Due to the aging of the equipments / high pressure parts, Life extension programme has been approved by GOI in March 1992 and was successfully completed in March’99 thus extending the life by 15 years. In view of the high grid demand in this region, this power station is being operated after conducting Residual Life Assessment (RLA) study. GOI has sanctioned a 2x500 MW Power Project (Neyveli New Thermal Power Plant – NNTPP) in June 2011 as replacement for existing TPS-I.

**THERMAL POWER STATION-II**

Thermal Power Station-II (7 x 210 MW), Neyveli, Tamil Nadu the 1470 MW Second Thermal Power Station consists of 7 units of 210 MW each. In February 1978, Government of India sanctioned the Second Thermal Power Station of 630 MW capacity (3 X 210 MW) and in Feb.’83, Government of India sanctioned the Second Thermal Power Station Expansion from 630 MW to 1470 MW with addition of 4 units of 210 MW each. The first 210 MW unit was synchronised in March 1986 and the last unit (Unit-VII) was synchronized in June’93. The power generated from Second Thermal Power Station after meeting the needs of Second Mine is shared by the Southern States viz., Tamil Nadu, Kerala, Karnataka, Andhra Pradesh and Union Territory of Pondicherry.

**THERMAL POWER STATION-I EXPANSION**

Thermal Power Station-I has been expanded (2 x 210 MW) using the lignite available from Mine-I Expansion. The scheme, TPS I Expansion, was sanctioned by Government of India in February 1996. Unit-I was synchronised in October 2002 and Unit-II in July 2003. The power generated from this Thermal Power Station, after meeting the internal requirements, is shared by the
Southern States viz., Tamil Nadu, Kerala, Karnataka, and Union Territory of Pondicherry.

**BARSINGSAR THERMAL POWER STATION**

Government of India sanctioned the Barsingsar Thermal Power Station 250 MW (2 X 125 MW) in October 2004. The units were commissioned in December 2011 and in January 2012. The power generated from this Thermal Power Station after meeting internal requirements is shared by the DISCOMS of the state of Rajasthan.

**TPS-II EXPANSION**

This project is consisting of two units of 250 MW capacity each. Unit-II attained commercial operation in April 2015 and Unit-I in July 2015. The lignite requirement is met through expansion of Mine-II. The steam generators of this project employ eco friendly Circulating Fluidised Bed Combustion (CFBC) technology. This technology has been adopted for 250 MW Capacity units for the first time in India.

**MINING PROJECTS**

NLC India at present has four open cast lignite mines namely Mine I, Mine II, Mine I-A and Barsingsar Mine. The lignite mined out is used as fuel to the linked Pit head power stations. Also raw lignite is being sold to small scale industries to use it as fuel in their production activities.

**UNIQUE FEATURES OF NEYVELI LIGNITE MINES**

A huge reservoir of ground water occurs below the entire lignite bed, exerting an upward pressure of 6 to 8 kg/cm². Unless this water pressure is
reduced before mining, it will burst the lignite seam and flood the Mines. This problem was overcome by continuously pumping out water round the clock through bore wells located at predetermined points and thereby reducing the water pressure at the lignite excavation area. Over the years, through continuous study and implementation of new methods, the quantity of water pumped out has been reduced from 50,000 GPM to 32,000 GPM. (For mining one tonne of lignite, about 13 tonnes of water has to be pumped out). The water level is continuously monitored through observation wells for proper ground water management.

MINE – I

The lignite seam was first exposed in August 1961 and regular mining of lignite commenced in May 1962. German excavation technology in open cast mining, using Bucket Wheel Excavators, Conveyors and Spreaders were used for the first time in the country in Neyveli Mine-I. The capacity of this mine was 6.5 MT which met the fuel requirement of TS-I. The capacity was increased to 10.5MT of lignite per annum from March 2003 under Mine-I expansion scheme and at present meets the fuel requirement for generating power from TPS-I and TPS-I Expansion.

MINE – II

In February, 1978 Government of India sanctioned the Second Lignite Mine of capacity 4.7 MT of lignite per annum and in February ’83, Government of India sanctioned the expansion of Second Mine capacity from 4.7 Million Tonnes to 10.5 Million Tonnes. Unlike Mine-I, Mine-II had to face problems in the excavation of sticky clayey soil during initial stage. The method of mining and equipment used are similar to that of Mine-I. The seam is the same as of Mine-I and is contiguous to it. The lignite seam in Mine-II was first exposed in
September 1984 and the excavation of lignite commenced in March, 1985. GOI sanctioned the expansion of Mine-II from 10.5 MTPA to 15.0 MTPA of lignite in October 2004 with a cost of Rs. 2295.93 crore. Mine-II Expansion project was completed on 12 March 2010. The lignite excavated from Mine-II meets the fuel requirements of Thermal Power Station-II and Thermal Power Station–II Expansion under implementation.

MINE-IA

Government of India sanctioned the project Mine-I A of 3 million tonnes of lignite per annum at a sanctioned cost of Rs. 1032.81 crores in February'98. This project is mainly to meet the lignite requirement of M/s TAQA Neyveli at Oomangalam's power plant and also to utilize the balance lignite to the best commercial advantage of NLC. The project was completed on 30 March 2003 within time and cost schedule.

BARSINGSAR MINE

GOI sanctioned implementation of Barsingsar mine with a capacity of 2.1 MTPA of lignite per annum at an estimated cost of Rs. 254.60 crore in December 2004. Both overburden and lignite production has been outsourced. Lignite excavation commenced on 23 November 2009 and production attained the rated capacity on 31 January 2010.

NEYVELI LIGNITE CORPORATION TAMIL NADU POWER LTD. (NTPL) (2 x 500MW)

NEYVELI UTTAR PRADESH POWER LTD. (NUPPL) (3 X 660MW)

Neyveli Uttar Pradesh Power Limited (NUPPL) is a joint venture between NLC India and Uttar Pradesh Rajya Vidyut Utpadan Nigam Limited, Ghatampur
in the State of Uttar Pradesh, for setting up of 3 x 660 MW power project. NUPPL has taken into possession of the entire land of 828 hectares required for this project. LOA for Steam Generator (SG) and Turbo Generator (TG) have been issued. Techno-Commercial evaluation for Balance of Plant package is in progress.

UPCOMING PROJECTS

NEYVELI NEW THERMAL POWER PROJECT (NNTPP) (2 X 500 MW)

The Neyveli New Thermal Power Project (2x500 MW) is being implemented at a capital cost of Rs.5907.11 Cr as replacement for the more than five decades old 600 MW Thermal Power Station I and adopts pulverized fuel firing technology. Consequent to re-tendering of Steam Generator package the Units are rescheduled to be commissioned in October 2017 and April 2018. LOA for Steam Generator package (NTA 1) and Turbo-Generator package (NTA 2) have been issued to M/s BHEL and detailed engineering activities, civil and mechanical erection works and supplies are in progress. LOA has also been issued for the Balance of Plant Package and the engineering and civil works, supplies and erection are in progress.

EXPANSION OF MINE I-A

In order to meet the additional requirement of lignite arising out of implementation of 1000 MW Neyveli New Thermal Power Project at Neyveli, expansion of Mine-IA is being implemented, which would result in raising the Mine IA capacity by 4 MTPA. Acquisition of required land has been taken up with Government. Ministry of Coal has accorded approval for mining expansion plan of Mine IA.
WIND POWER PLANT (51 MW)

NLC India is implementing Wind Power farm of capacity 51 MW at Kazhuneerkulam in the State of Tamil Nadu at an estimated cost of Rs. 347.14 Cr. M/s LeitwindShriram Manufacturing Limited is the implementing agency and so far 29 Nos. of Wind Turbine Generators (WTG) have been commissioned and the balance 5 Nos. are expected to be commissioned during the year 2016. Power Purchase Agreement has been signed with TANGEDCO.

NEYVELI SOLAR POWER PROJECT (2 X 65 MW)

NLC India is setting up 130MW solar power project at Neyveli, Tamil Nadu. The project is implemented through EPC route and scheduled to be commissioned in 2016-17. M/s BHEL and M/s Jakson bagged the contract and LOA has been issued. Power Purchase Agreement has been signed with TANGEDCO.

BITHNOK THERMAL POWER PROJECT (250 MW)

Bithnok Thermal Power Project (250MW) with the linked lignite mine of 2.25 MTPA capacity at Bithnok in the State of Rajasthan is being set up at an aggregate estimated cost of Rs.2709.93 Cr. Power Purchase Agreement has been signed with Rajasthan DISCOMs. Agreement for supply of 25 cusecs of water from IGNP canal has been entered into. Government of Rajasthan (GoR) has issued award for acquisition of 1175.87 hectares of private land in Bithnok and 1863.184 hectares of Government land will be diverted to project by Government of Rajasthan after takeover of private land. The project is proposed to be implemented through Engineering, Procurement and Commissioning (EPC) contract mode and is expected to be commissioned during the year 2020. Ministry of Coal has accorded approval for revised mining plan in June 2015. EOI short listing is completed and techno-commercial evaluation is in progress.
BARSINGSAR THERMAL POWER PROJECT EXTENSION (250MW)

Lignite based Thermal Power Plant with a capacity of 250MW as an extension of the existing power plant at Barsingsar is being set up. The fuel requirement for the above power plant is to be met from linked Hadla Mine of 1.9 MTPA and the existing Barsingsar Mine. The aggregate estimated cost of the project is Rs.2635.04 Crores. All statutory clearances have been obtained. Government of Rajasthan has allocated Mining Lease area of 15.66 Sq. km. The project is proposed to be implemented through Engineering, Procurement and Commissioning (EPC) route and is expected to be commissioned during the year 2020. EOI short listing is completed and techno-commercial evaluation is in progress.

SIRKAZHI THERMAL POWER PROJECT (3960 MW)

It is proposed to set up a coal based thermal power project with an overall capacity of 3960MW, in two phases, at Sirkazhi in the coastal district of Nagapattinam, in the State of Tamil Nadu Advance Action Proposal at a cost of Rs.56.52 Cr for taking up pre-project activities is in progress. NLCI has identified Thirumullaivasal as the site for locating the power plant. Feasibility report is under preparation. Action has been initiated for floating tender for preparation of CRZ map for the project. Application for land acquisition has been submitted to Government of Tami Nadu for issue of administrative sanction for acquisition of land for this project. Preparations of EIA/EMP report, DPR for captive coal jetty are in process. Change in configuration to 5 x 800MW using super critical technology is under active consideration.

THERMAL POWER STATION II -2nd EXPANSION (2 x 500 MW)

It is proposed to increase the power generating capacity by adding another 1000MW thermal power plant as the second expansion to the existing TPS-II at
Neyveli. A new mine, Mine-III of capacity of 9.0 MTPA is proposed to be set up to exploit the mineable lignite reserves of about 380 MT available in the south of the existing Mine-II to meet the fuel requirement of the proposed thermal power plant. Advanced Action Proposals (AAP) of Rs.7.05 Cr for Mine-III and Rs.1.80 Cr for TPS-II Second Expansion for taking up phase-I pre-project activities were approved. Action has been initiated to enter into Power Purchase Agreement with DISCOMs of Southern States. PPA has been signed with TANGEDCO, Kerala SEB, Puducherry, Government of Andhra Pradesh, Government of Telangana. Change in configuration to 2 x 660MW using super critical technology and augmentation of Mine-III capacity to 11.5 MTPA is under active consideration.

MINE II – AUGMENTATION

It is proposed to augment Mine-II from the present capacity of 15.0 MTPA to 18.75 MTPA, in order to meet the lignite requirements of TPS-II including Expansion for operating at a higher Plant Load Factor (PLF).

NLC Tamil Nadu Power Limited (NTPL), is a joint venture company of NLC India Ltd (formerly known as NLC Ltd) and M/s TANGEDCO (Tamil Nadu Generation and Distribution Company), incorporated under the company act. The Equity participation between NLC and TANGEDCO is at the ratio of 89:11. GOI had issued sanction for the implementation of coal based 2 x 500MW Thermal Power Project by NTPL at Tuticorin at an estimated cost of Rs.4909.54 Cr. Unit 1 and Unit 2 have been declared for commercial operation w.e.f. 18 June 2015 and 29 August 2015. RCE-2 for the project (Completion cost of the project) works out to Rs.7293.48 Cr. (June-15 base). Power Purchase Agreement has been signed with TANGEDCO, ESCOMs of Karnataka State, Puducherry Electricity Department, Kerala State Electricity Board and DISCOMs of Andhra Pradesh. Power evacuation from this project is being carried out by M/s Power 35
Grid Corporation of India. NTPL has signed a fuel supply agreement with Mahanadhi Coal fields Limited for supply of 3.0 MTPA of coal and in order to meet the shortfall in requirement, a contract has also been awarded on M/s. MSTC for supply of imported coal.

CENTRE FOR APPLIED RESEARCH AND DEVELOPMENT (CARD)

Centre for Applied Research and Development (CARD) is the in-house Research and Development Centre of NLC India Limited and has been recognized by the Department of Science and Technology since 1975.

The testing and Research and Development facilities were upgraded under a project (LERI) sponsored by United Nations Industrial Development Organization (UNIDO), Vienna during 1995-2000. The main objective was to strengthen CARD to improve its capability to provide analytical, environmental monitoring, Research and Development, technology and services to industry and the Government. Under this project, services of national and international experts were utilized for lignite utilization and opencast mines, power stations related problems and acquired sophisticated equipments, training and established combustion and gasification testing facilities.

The major functions of CARD are carrying out Science and Technology Projects (Ministry of Coal), In-house SandT Plan Projects, Pollution level measurements, Quality control Testing and Consultancy services, Pilot Plant studies based on Research and Development and commercialization of technology developed, Coordination of SandT projects taken by other NLC Units, Institutional services for students, Special studies for operation and new schemes etc.
CARD is carrying out various Research and Development works on lignite utilization, diversification, product development, by-product utilization, solid waste management, wasteland reclamation, corrosion evaluation and prevention etc. For implementing these projects, CARD is associating with outside agencies like, IIT-Delhi, IITM-Chennai, IIT-Kharagpur, CIMFR-Dhanbad, TNAU-Coimbatore, BHEL-Trichy, Anna University-Chennai, Madras University-Chennai, Annamalai University-Chidambaran, NIIST-Thiruvananthapuram, VIT-Vellore, NIT-Trichy, CECRI-Karaikudi, VCRC-Pudhucherry, IRERC, Kollam, etc. Based on the Research and Development works, some of the processes have been scaled up to pilot plant scale. The projects include Ministry of Coal funded Research and Development projects as well as in-House SandT funded projects. CARD has completed seventeen projects funded by Ministry of Coal and seventeen projects under in-house Research and Development. There are two on-going Ministry of Coal funded projects and nine on-going projects under in-house Research and Development and a study on upgradation of brown coal in association with M/s Kobe Steel Ltd., Japan with a funding from NEDO, Govt. of Japan. CARD/NLC has conducted extensive studies on mine spoil reclamation, integrated farming system, slope stabilization, ash pond reclamation, utilization of Fly ash, bottom ash and bottom slag etc. Corrosion studies have been conducted in SME structures of Mines to develop suitable coating material. Corrosion studies are also being conducted in SWC pumps to prevent erosion-corrosion due to adverse conditions in mining environment.

Testing Facilities

CARD has a well-established analytical facility and is rendering analytical services towards quality control of various products/materials used in mines, power stations and other service units as well as outside agencies. The analytical
testing facility includes lignite analytical, microbiology, material testing, environmental section, soil mechanical section, metal testing, paint testing, general analytical, petrography etc.

The sophisticated instruments available include Scanning Electron Microscope with EDS, ED-X-RAY Fluorescence Spectrometer, Elemental Analyzer, TGA/DTA, Heating Microscope, Inductively coupled Plasma spectrometer, Atomic Absorption Spectrometer, High Pressure Liquid Ion Chromatograph, Nitrogen Analyzer, Fluorescence Microscope, Petrography microscope, Metallurgical Microscope, Surface area analyzer, Continuous Ambient Air Quality Monitoring System, Power quality analyzer etc. CARD facilities are available for internal use and utilized by other agencies like SAIL, BHEL, MECL, GSI, STCMS etc.

New Products Developed

CARD has patented a process for the production of potassium humate from lignite. Potassium humate helps to build up organic matter status in soil and is a plant growth stimulant. By commercialization of this product, lignite will have a diversified utility in producing a value added product and thereby promoting agricultural growth in the country.

CARD successfully completed a joint Research and Development project with National Institute of Interdisciplinary Science and Technology (NIIST), Thiruvananthapuram, for development of a process for the production of activated carbon from Neyveli lignite. This is a novel method for the production of activated carbon from lignite. Zeolite has been synthesized from Neyveli lignite fly ash under the consultancy project given to IIT/Kharagpur for the reduction of calcium in blow down water of Thermal Power Stations. Feasibility
studies on using zeolite are proposed on pilot scale water treatment plant at CARD.

**Pilot Plants**

Potassium Humate: A pilot plant of capacity 7.20 Lakh litres per annum has been developed successfully. Humic acid is extracted from lignite. Potassium humate is used for agricultural application and for land reclamation. Obtained Golden Pea-Cock Eco-Innovation Award during the year 2008 by World Environment Foundation. Biofertilizer: Biofertilizers like Rhizobium, Azospirillum, Azotobacter and Phosphobacteria are produced using lignite as a carrier material. The products are mainly used in mine spoil/ash pond reclamation and green cover development in Afforestation. Activated Carbon Pilot Plant: A pilot plant was erected for development of a process for production of activated carbon from lignite. The product was tested its quality and further studies are in progress for improvement. Zeolite from fly ash: A Bench scale plant has been established for production of zeolite from fly ash.

**Conclusion**

In this chapter the relationship of job satisfaction and attitudes, Theories of satisfaction, the advancement of job satisfaction studies, the determinants of job satisfaction, the importance of job satisfaction studies and profile of the NLC Ltd., has been presented elaborately. In the next chapter II, the review of literature has been presented.