Rebuild of paper machine at Nepa mills

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ABSTRACT

This paper attempts to high light the successful rebuild of Paper Machine (30,000 TPA) of Fifties make, installed at Nepa. The rebuild job was first of it's kind for a large capacity newsprint machine taken-up by a running newsprint manufacturing unit without disturbing current production. It also involved simultaneous renovation/modernisation of major constituent plants of the integrated newsprint mill at Nepanagar.

Considering the obstacles/constraints involved in handling such a huge size rebuild job, in retrospect, the authors feel satisfied with the success in implementing this unique experiment at Nepa. The objectives of the scheme were primarily to renovate the 30 years old ageing plant in general and improve productive efficiency of Paper Machine No. 1 in particular, to bring about improvement in quality of newsprint, optimum utilisation of existing capacities, conserving use of raw materials energy etc.

This paper describes briefly the various stages of the rebulid exercise at Nepa. The authors have gone in detail on some of the aspects as they consider those to be important for any rebuild job of similar nature in the Paper Industry. No doubt the benefits accrueing from the rebuild scheme are wide ranging with immediate and a long term impact. Production from the rebuilt Paper Machine has gone-up from 70 TPD to 105 TPD presently which further will go upto 160 TPD after few remaining jobs are completed. This alone will vouch for the success of the rebuild programme.

1. INTRODUCTION

Nepa Limited, formerly known as the National Newsprint and Paper Mills Limited commenced production in the year 1955-56. Nepa is the pioneer and first integrated newsprint mill of the country with a capacity of 30,000 TPA. Nepa used salai hardwood stone ground wood pulp mixed with Bamboo chemical Pulp in the ratio of 60:40 respectively. During 1964-65 an expansion and balancing scheme was taken-up to augment mill capacity from 30,000 TPA to 67,500 TPA by adding a new street of 25,000 TPA Cold Soda Pulping Plant, extension of the Bamboo chemical pulp mill to 25,000 TPA a Soda Recovery Boiler and installing new Paper Machine of 37,500 TPA. Other utility services were also augmented to meet the target of 67,500 TPA. Another objective was to catch-up with the fast technological development in pulp and Paper Industry and in particular in Newsprint Industry which was far behind. To attain self-sufficiency in newsprint, three more newsprint mills came-up in eighties in the country. Nepa produced heavy grammage newsprint and its quality could not match the characteristics of imported newsprint for which the modern off-set printing presses were designed. To keep pace with the latest trends Nepa was left with no alternative but to take-up an extensive renovation and modernisation programme of the mills. It, thus, launched an ambitious Renovation, Modernisation and expansion Scheme in 1981-82 (RME Scheme) at an initial estimate of Rs. 35.41 Crores. The objectives

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and salient features of the RME Scheme were as under :—

— Capacity increase from 67,500 TPA to 88,000TPA.

— Increase machine speed of PM-1 from 360 MPM to 700 MPM with normal operating speed of 450 MPM with rated capacity of 50,500 TPA.

— Improve quality ot newsprint to meet international standard of 49 GSM.

— Incorporate latest technology and process control equipments discarding obsolete and outlived equipments/components.

— Reduction in energy consumption per tonne of output.

— Increase overall efficiency of Paper Machines.

The RME Scheme was put on anvil in 1984 after Government approval. Initially, the Government released Rs. 2.0 Crores to meet pressing need for urgent maintenance works from which immediate benefit flowed. The rebuild of Pusy & Jones make fourdrinier Paper Machine of early fifties having a maximum capacity of 30,000 TPA was proposed to be raised to 50,500 TPA. Due weightage was given in the choice of new equipment to the proposed furnish in the ratio of 35% Bamboo Chemical Pulp, 35% Salai/Bamboo Cold Soda Pulp, 30% Salai Stone Ground Wood and a maximum broke addition of 15% of the admixture.

2. WHY REBUILD

Both before and after the massive Renovation work carried out by Nepa on Paper Machine No. 1, many have queried the need for this expensive venture instead of going in for a new Paper Machine. Our answers are—

a) Installing a new machine in the present site was not possible.

b) Existing infrastructural facilities had to be fully exploited.

c) The current production was to be maintained with minimum shut.

d) Economics of a new machine could not permit the various related issues.

Besides, the age old Pulp and Paper Industry of the country need to adopt and update their plants and equipments in order to keep pace with the latest technology to increase productivity and make acceptable quality product. There was no alternative left but to update the plant and machinery at Nepa continuously as an on-going process instead of facing obsoloscence in the near future. The need of the hour was optimum utilisation of installed capacities. Nepa experiment has demonstrated that the Renovation and adoption of new technology, should be an on-going process. While renewal, replacement and the rebuild work is taken on hand, there will be loss of production during shutdown of Paper Machine which is un-avoidable. Even than, the overall cost of a major rebuild scheme will be around 50% of the cost of a new machine erected from grass root.

3. REBUILD OF PAPER MACHNE

Keeping in mind the above view point, a bold decision was taken by Nepa to rebuild Paper Machine No. 1 extensively with entire replacement of approach flow system, head box, wire part, press section, calender electrical sectional drive and the Winder as part of its RME Scheme. The existing dryer part and pope reel after detailed survey was decided to be used with necessary replacement and repairs Based on the design configuration of the machine and identifying the imbalances, the rebuild work of Paper Machine was initiated in 1984. The salient featutes of the rebuild work are discussed below:—

3.01 **Approach flow system**

Approach flow system was modified for higher throughput of the machine incorporating 4-stage centricleaning and 3-stage screening systems. New RCC machine chest and a blending chest were constructed. A microprocessor (MOD-30) based ratio control svstem for 5-streets of pulps was introduced to achieve uniformity of the stock furnish.

3.02 **Headbox**

The open head box was replaced with a modern Beloit Hydraulic thin channel converflow head box with pulsation attenuator and a stream flow valve.

3.03 **Wire part**

The fourdrinier having table rolls etc. was rep-

laced with a new fourdrinier having stationary drainage elements alongwith a top wire unit (Belform). The design of cantilever beams for bottom and top wire unit consist of 'C' type framing. Suction couch roll was reused after modification of internal suction box.

3 04 Press Part

An open draw straight two nip press was replaced with a closed draw latest design Beloit tri-nip press consisting of a suction pick-up, double felted suction venta-nip Ist press, a single felted suction, 2nd press and single felted venta-nip 3rd press.

Beloit controlled crown Ventex covered grooved rolls in Ist press bottom and 3rd press top position were provided. Old suction press roll shell was used as pick-up roll. The tri-nip was designed for the maximum nip pressure on the Ist Peess 70 KN/M, 2nd Press 90 KN/M and 3rd Press 105 KN/M.

3 05 Dryer Part

The dryer section was divided into three mechanical groups for better draw control. To accommodate new press section, first two dryer cylinders were removed and position, of baby dryer was shifted. All felt dryers were removed. The spur gears of the first mechanical group of dryer section having 8 cylinders were replaced with new helical gears.

First group consisting of 8 dryers and one baby dryer was provided with a Unirun felt Second and third group comprising of 14 and 12 dryer cylinders respectively were provided with top and bottom synthetic felts. Old felt rolls and dryer cylinder were retained after the same were dynamically balanced for maximum machine design speed of 750 MPM. Completely closed hood with heat recovery units and pocket ventilation system of 23 blow boxes were incorporated in the dryer part.

3 06 Steam and condensate system

New cascade blow through steam and condensate system were provided with new steamfits and rotary syphon assemblies.

3 07 Calender

Closed 'A' frame, 8 rolls calender stack was replaced with an open frame Beloit fixed, queen 4 roll calender stack having provision for 6 rolls. The stack comprise of top and bottom Beloit controlled crown rolls. Calender cooling system with refrigeration unit and hot water circulation system for queen and intermediate rolls were also incorported. The calender stack was designed for maximum nip loading of 114 Kg/cm.

3.08 Pope reel

The pope reel has been suitably modified to a horizontal beam type reel reusing old reel drum for building jumbo paper roll upto a maximum of 2000 MM diameter,

3.09 Electric Drive

A new thyristor controlled sectional drive was installed with individual draw control and speed digital display on individual section to facilitate smooth operation. New sets of indrive shafts, reduction drive gear boxes and DC motors were incorporated.

New power distribution and control systems for paper machine No.1 equipments and air conditioned control room were incorporated and housed in a newly constructed building.

3.10 Broke System

New SS press pit, UTM Pulper for dryer, calender and reel broke, HD cleaner and deflaker were added in the system.

3 11 White water System

New SS back water tank, Broughten white water filter for fibre recovery and machine showers pumps were provided in the system to reuse maximum back water available from the system.

3.12 Vacuum system

To meet the enhanced vacuum demand of the machine, 6 nos new indigenous vacuum pumps and 2 nos vacuum blowers for low vacuum application were installed. Old 6 nos Nash vacuum pumps were re-used.

3.13 Controls

On-line continuous process control "AccuRay 1180 Micro" System for MD Basis Weight and Moisture Control and caliper measurent of finished newsprint was installed.

Auxiliary control instrumentation in various sections of Paper Machine comprising of level controllers, Consistency controllers, Pressure controllers etc. were provided.

3.14 Winder

New Jagenberg Vari-Dur two-drum winder of the latest design, having nominal trimmed width of 5,500 MM, minimum operating speed of 1700 MPM and maximum rewind diameter of 1525 mm was incorporated alogwith indigenous thyristor drive. The design takes care for uniform and controlled tension to give optimum density of finished rolls.

3.15 Results of Rebuild

After the successful completion of the rebuild work, the Paper Machine was commissiond in Nov.89. Newsprints production from PM-1 on constant basis commenced within 6 weeks although teething troubles in many areas such as centricleaning system, and condensate system and the tuning & synchronisation of the thyristor drive etc did not allow targetted production. The quality of newsprint produced was found to be satisfactory compared to its characteristics befor rebuild. Comparative study of these characteristics is made in Table-1.

TABLE--1

Sr. No.	Paramaters	Unit	Before rebuild	After rebuild Traget	Actual
1.	Basis weight	gsm	52-55	49±1	48-52
2.	Burst	factor	9.85	10.00	9.85
3.	Breaking length				
	MD	mtrs	2692	—	3016
	CD	mtrs	1858	—	1752
	Avg.	mtrs	2275	2400	2384
4.	Caliper	micron	108	75	75
5.	Two sidedness w.r,t, brightness (bottom/top)	ratio	0.88	0 95	0.94
	w.r.t. smoothness (bottom/top)	ratio	0.86	0.85	0.71
6.	Smoothness	ml/min	700	300 max.	300
7.	Formation (NUI)	factor	33.50	14.70	26 26
8.	Porosity	ml/min	2000	500	550
9.	Avg. machine speed	mpm	300	450	411
10.	Avg. production per day	MT	71	160	105
11.	Steam consumption of per ton of newsprints	MT	3.20	2.00	2.50

Note ; Efforts to accomplish the targetted norms are continued to attain the same.

Tha problem areas and those needing improvement for better results and to achieve the targets wore identified. They are being tackled one by one. Some of the benefits achieved are enumerated below--

- Homogeneous and uniform newsprints furnish
- High stock cleaning efficiency
- Improved runnability with lower grammage
- Improvement in Web formation
- Reduction in two sidedness
- Improved linting properties
- Considerable reduction in porosity
- Improvement in press dryness.
- Increased life of mechine clothing
- Reduction in steam consumption
- Reduction in use of fibre resulting in conservation of scarce raw materials
- Improvement in the quality of reel build up reducing rejects
- Improvement in power consumption per tonne of newsprints with the increase in out-put
- Lower water consumption due to closed system
- Improvement in operating facilities
- Uniform quality of finished product
- Increascd machine efficicncy and productivity

It may thus be seen that by and large the objectives have been accomplished.

4. IMPLEMENTATION METHODOLOGY

While deciding the RME Scheme and in particular the re-build work of paper machine, careful thought was given towards implementation methodology for the successful accomplishment of the objectives.

For proper implementation of re-build job of this magnitude undertaken for the first time in the country without dis-locating running of the existing plant and equipments, Nepa considered two options available before it -- (i) To have single agency to execute the entire RME Scheme on turn-key basis and (ii) To directly handle with their technical personnel the re-build work as well as the renovation works of the various individual plant e.g. Re-build work of paper Machine, Boiler, T.G., Coal and Ash handling system. pulping plants, Caustic Chlorine Plant, Soda Recovery Plant, Chipper Complex, Power Distribution System, Railway Yard etc.

After due consideration of the various factors which include the non-availability of a single agency for such complicated work and the need to maintain current production un.interruptedly, Nepa took the bold step and decided the implement the RME Scheme by its own technical personnel. The chief reason being availability of experienced personnel in-house. This step proved to be right and yielded the expected results in addition to speedy implementation at minimum cost.

4.01 CONSULTANT

Nepa management with an open mind invited world renowned machine builders and deputed its senior technical personnel to various paper mills and manufacturing works of the machine builders within the country and abroad, to be abreast with the modern techniques, technological development taking place and to asses the technical efficiency of the various proposals for the re - build work. This greatly helped in deciding the right design concept and the machine configuration.

Services of renowned consultants like Jaako Poyry, Engineers India Ltd. Dr. Lee Eberhardt, Sri Raghu Consultants, Tata Consultants were availed in formulation of detailed Project Report of the RME Scheme.

After the finalisation of the design concept and framing up the specification, the selection of machinery manufacturers was finalised. The major criterion followed in selection of the machine suppliers for critical plants and machinery was the technology base adopted by them, respective support from renowned foreign/indigenous manufacturers, their manufacturing capabilities and the performance of their equipments under operation at various paper mills. The manufacturer who had the facilities of taking up the detail design engineering work was preferred.

Further, to save scarce foreign exchange due consideration was given to indigenous facilities keeping in view the above points and the time schedule a calculated decision was taken in favour of indigenous suppliers/manufacturers.

4.02 **To generate data and condition monitoring**

While selecting the machine builder and the engineering consultant, prime responsibility lied with the owner to ensuse that all necessary technieal information and design drawings of the old machine were available and the existing civil structures take care of the new equipments.

A detailed technical survey of the old parts was taken-up with the help of the selected machine builder and their foreign collaborators to bring-out the exact condition of these parts and the type of repairs/rebuild work required to match with the rebuilt machine. It was not, however, possible to open out the complete machine to know the details of the inner parts as this could be accessible only during major shut-down of the machine for the rebuild and during replacement. Mis match of several parts were faced which required complete refabrication and manufacturing of parts at site, enhancing machine down-time. The dryer part, old couch roll, suction press roll, and the Pope reel were thoroughly checked and necessary requirements could be added at a later date. The condition monitoring of these parts before the rebuilt was also carried-out with the help of latest techniques of vibration analysis. A right decision for replacement of bearings, dryer gear train and the dynamic balancing of the felt rolls, dryer cylinders and other important rolls could be taken in advance to initiate corrective actions.

4.03 **Pilot Plant**

It was essential to ascertain, by means of Pilot Plant trials, runnability and the behavior of the proposed furneih along with the various characteristics of the paper produced and keeping in view the newest concept of twin wire fourdrinier machine to run at maximum 700 MPM accepted by Nepa. With the assistance of the machine builder a pilot plant study of the proposed furnish was made in USA in the presence of Nepa Officials. Based on the results of the study necessary changes in the design of the machine components were finalised.

4.04 **Training**

Training of personnel at all levels and of all discipilines to acquaint with new plant and machinery, was planned. Such teams of workman and middle and Senior level technical Officers were deputed within India and abroad to various paper mills and to the machinery manufacturing works. This enabled the personnel to possess updated technical information before take-over of the equipments with easy acceptability.

4.05 **Planning of the Rebuild Work.**

The project team had identified all the works under various disciplines to be undertaken. These jobs were further divided in two categories viz works to be accomplished without any stoppage and during short spell of paper machine shuts and jobs which could be done finally only during the major shut of paper machine. Simultaneously, the sequential operation of individual activities were planned in detail for execution. This resulted in accomplishing many works of even important and critical areas without disruption of current production The unique example is that of the construction of UTM pulper Vat along with Calender foundation and their erection work while the machine was still operating and was finally commissioned with only a small shut Various works, which could be completed before the major rebuild were taken up, are listed below :

- Construction of machine chest, blending chest, dry end broke chest and centri-cleaner reject vats and pump foundations.
- Construction of electricai switchgear building and installation of power distribution equipments.
- Installation of new winder at new location in front of old winder keeping old winder in running condition.
- Installation of vacuum pumps.
- Commissioning of new pressure screen.
- Foundations of modular steel structure of press section.
- Construction of mezzanine floor between the two machines and extension of paper machine building.
- Installation of hood exhaust fans and PV fans on mazzanine floor.
- Installation of calendering cooling and hot water circulation system equipments.

— Installation of steam and condensate system equipments.

— Construction of foundation for fan pump, pressure screens, auxiliary pumps etc.

4.06 Critical shut-down of paper machine

A critical shut-down was planned metriculously after all components and consumables were in hand.

The project team had a herculean task of arranging not only the equipments but every small components required for the civil construction, electrical installation, mechanical and instrumentation erection involving over 50 Vendors and sub-vendors. A task force for procurement of emergent needs was developed to make them available at side within the shortest possible time.

Various contractors for civil construction, mechanical erection, electrical installation, instrumentation etc. were engaged and kept in readiness.

The planning of requirement of skilled manpower and qualified supervisors was carefully assessed for the total shut-down period. Their availability on round the clock basis was ensured. The Contractors were called upon to maintain their best team and were motivated for the highest productivity.

The dynamic balancing work of all dryer felt rolls Pope reel drum and other rolls could be arranged at site. A meticulous balancing programme was prepared along with erection works in progress and was managed very efficiently. A contract was awarded for this work to renowned consultant in Madras.

4.07 Project Team

The Project Team consisted of technical officers headed by a Project Manager. These experienced Officers were assigned the important areas e g. civil & structural works, electrical, mechanical, instrumentation, process engineering drawing office etc. Personnel conversant in the respective plants of the running mills were drawn for the project implementation activities from time to time. The availability of experienced hands from the mills readily was very useful in resolving impediments that arose during the actual execution of the RME Scheme. The Planning Cell was responsible to prepare schedules for shut-downs in consultation with the different plant personnel, so as to simultaneously carry out other related maintenance jobs with minimum loss of production. It is an unique example of close coordination between project team and the plant personnel at all levels which resulted in speedy completion of the rebuild job. The project team also handled i) Co-ordination with vendors and sub-vendors, ii) quality check of works along with Supervisors of Plant/equipment manufacturers and iii) Trials, Commissioning and Performance Test.

The main task of coordination was looked after by the project team. During execution works the problems of interference of piping, cable trays and various other such old structures had to be sorted-out within shortest possible time. The problem was more acute due to the low head room design of the paper machine building and where there was no EOT crane facility on the tending side of the machine. The construction work of press, calender foundation and the press drive foundations posed a challange and this could be resolved with the involvement of CMD NEPA alongwith the engineering consultant. It is a matter of pride that these foundations of a critical area were constructed on existing old civil structures satisfactorily with better results.

During execution of the erection works mis-match of old and new components supplied by the Vendor disturbed the schedule considerably. The deployment of locally available fabrication crew and the mills workmen and its mechanical work shop facilities curtailed the delays.

Initially, it was planned to carry-out modification of old couch roll, conversion of old suction press roll in to pick-up roll, modification of Pope reel drum and the dynamic balancing of all old felt rolls at the Vendors works 2000 KM away from Nepa site, A timely decision was taken in consultation with the Vendor to take up all these modification and the dynamic balancing works at Nepa site only. These jobs could be completed by the Vendor with the help of in-house workshop facilities within shortest possible time.

4.08 Monitoring

Continuously monitoring of the various sections of the rebuild work was an essential feature from its start till completion. Detailed PERT/CPM Net Work charts were closely reviewed at frequent intervals-almost on weekly basis. Corrective steps were promptly

initiated to catch-up with delays and where necessary the Charts were updated. Review meetings with individual Contractors/vendors were held both at Nepa and at the office of the Vendors by a team to isolate bottlenecks and to speed-up decisions from design , fabrication and erection stages.

During the critical shut-down period monitoring of the rebuild work of each section of the paper machine had to be done almost on a continuous and hourly basis to minimise delays in getting the replacement of original parts, repairing of worn-out parts, mis-matched parts etc.

4.09 Management Information System

An effective MIS was part of the project activities. This involved reporting progress of work by each officer in his respective area to the Project Manger. Periodical reports were sent by the project division to CMD and consolidated reports to the Board of Directors and to the Ministry in the Govt. of India. The Vendors and the Contractors were also required to submit periodical progress reports to the project authorities on the progress of design engineering, manufacture, supply and fabrication activities. The above mentioned reports were the basis for holding periodical meetings with the suppliers/contractors.

Review meetings were also taken by the Ministry at the highest level in which CMD, Nepa and Chief Executives of major contracting firms participated besides the officials from the project division.

5.0 Check list

In undertaking a rebuild job in the paper industry the following check list would be found useful.

- Selection of technology vis-a-vis the raw material.
- Identification and the extent of problems in existing paper machine. Machine operators are the best judge.
- A strong in-house technical team consisting of experienced personnel to handle rebuild work.
- Plant visits, attending Seminars and in-house training of personnel at all levels particularly of the operating and maintenance staff.
- Generation of data and drawings of old structures and parts which are to be retained to prevent last minute rush and to avoid problems of mismatch etc.
- Collection of full information of latest developments and facilities available with the manufacturers.
- Visit of the implementation engineers to other mills where major renovation work has been done and to exchange views.
- Detailed Survey of all parts to be retained and assess their conditions to match proposed operating parameters.
- To carry-out diagnostic study and vibration analysis in advance to decide corrective measures.
- To have laboratory trials of the furnish and as far as possible to carry-out pilot plant trials of the proposed furnish vis-a-vis the end product characteristics.
- A careful selection of the design engineering consultant and machinery manufacturers and suppliers and various other Vendors and construction and erection contractors.
- To create a well equipped in-house work shop facility to meet emergent needs
- To keep a force of skilled manpower of the existing plant alongwith the contractors for smooth take-over.
- During major shut down period, 3 shift working to be arranged.
- Pre-assembly of all components before correction, at manufacturer works is recommended.

6.0 CONCLUSION

The majority of Paper Mills in India were established a few decades ago. They are mostly medium sized units with 30-60 TPD capacity as compared to much larger capacity machines in advanced countries. This is chiefly owing to investment cosntrained and non-availability of adequate raw materials resources. Some of these units have been established with second hand machines imported from abroad It is in this back drop, the concept of rebuild of existing machines

which necessarily lag behind in technology and cost effectiveness, assume importance. The Nepa experiment on rebuild of its Paper machine has proven this point beyond doubt. With depleting raw material scenario and galloping cost per tonne in investment on a large sized paper units the choice should fall on rebuild technology to attain increased out-put from the same equipment and facilities with only marginal investment at much shorter time. Re-build technology should be taken-up rebuild jobs for the Industry should be developed. The authors will feel gratified and an acknowledgement of their efforts in this regard if this paper provokes a debate on the subject among the participants in this seminar and the Captains of the Industry.

Authors wish to record their grateful thanks to the Management of Nepa Ltd. whose successive Chairman and Managing Directors gave the inspiration, guidance and support for pioneering the RME Scheme of which the rebuild of paper machine was a part and we as members of the project team owe much to all who have helped in accomplishing the objectives of the rebuild.