

NO INFORMATION EVER GOES WASTE - NO WORK EVER GOES IN VAIN

There have been many occasions in my career when information gathered at some stage became useful at some other stage for solving a problem. This would apply to information to all types - gathered through study of books, listening to others, inspections, visits of factories and above all doing work with one's own hand. What follows is a description of an instance belonging to the category last mentioned.

I was DEE/Traction, Tamabaram at that time. The year 1963. It was a Sunday morning. At about 10.00 a.m., I was informed in my house by Control that a level crossing gate near Saidapet Station on the Electrified section had got locked against road traffic and could not be opened even after the trains had cleared the track-circuited sections concerned on all the three tracks. This was causing commotion from road users. The signalling supervisor concerned had come to site but he could not tackle the problem. He had however reported that some signals in the vicinity were flickering i.e. changing from one aspect to another continuously.

I had observed such a phenomenon of flickering about a month earlier, during an experiment that I had conducted at midnight near Minambakkam Traction Sub-Station. Observations I had made at that time led me to guess that the problem now reported from Saidapet could arise from some disturbance in the power supply for the signalling system.

On my enquiry, the controller stated that at that time we were taking 5KV supply as usual at Egmore Sub-Station but we were on 33KV Emergency supply at Minambakkam Sub-Station.

There was a 33KV transmission line of the Railway to carry power from Egmore to Minambakkam and this was the normal AC supply arrangement for Minambakkam. At times, when we had problems with the transmission lines or some restrictions on the quantum of power intake at 5KV at Egmore, we used to avail the Emergency supply at 33KV at Minambakkam. Both the 5KV and 33KV supplies were from the Madras Electricity system of

the Madras State Electricity Board. On the day in question, we were on Emergency supply due to restrictions on 5KV intake.

On my directions, the Controller checked up with MES and got a confirmation that all was well on their side. Not satisfied, I telephoned the Superintending Engineer of MES. He also replied that all was normal on his side. I asked Control to inform the DSTE and proceeded to Minambakkam Sub-Station, arriving there in about 20 minutes.

On my instructions, permission was taken by the Control from MES for us to load their 5 KV system at Egmore and to switch off the 33 KV emergency supply at Minambakkam. The required operations were carried out by the operators at Egmore and Minambakkam. As soon as the operations were completed and power supply changed from emergency to normal at Minambakkam, the problem at Saidapet, 10 kms away, disappeared as if by magic. The flickering of signals stopped and the level crossing gates could be opened to road traffic. I went home relieved that through my intervention, a strange problem had been solved.

The experiment that I had conducted earlier was precisely this. I had brought a small petrol engine driven generating set to Minambakkam Sub-Station to see if I could use it for giving power supply to some portion of the signalling load, under certain emergency conditions. I found that as soon as the power supply was changed from Normal to the generating set, some of the signals in the vicinity started dancing green - red - green etc.,. The frequency of flickering was changing with the speed of the generating set. The Signal Inspector who was with me at that time of the experiment pointed out that this phenomenon could arise from the difference in frequency between the AC supplies to adjacent track circuit sections. The possibility of using a generating set was abandoned.

But the lesson of that midnight experiment came in handy for attempting a solution to the Saidapet problem. I knew that Saidapet was located on the border area, the tracks in the direction towards Minambakkam being fed with power supplies for signals from that Sub-station and the tracks in the opposite direction i.e. towards Egmore being fed from the Egmore substation. I reasoned that the kind of flicker could have come about if the

frequencies of the two supplies were different. I guessed that the problem of the level crossing gate getting locked might also be due to the same cause. As it happened, the problem disappeared once both the supplies were derived from the same source.

After I reached home, I spoke to the Superintending Engineer/MES explaining to him what all had happened. He checked up once again with his people and confirmed to me that indeed there had been a "separation problem" in the Madras Grid for some time that day and it was quite possible that the Railway got supplies at slightly different frequencies at the two point of supply. He apologised for the inconvenience.

(Note : It is possible that the above technology is now out-of-date. We do find emergency generating sets installed at many places on Electrified Sections and they are pressed into service quite often. Nobody hears of the "flicker" problem. May be, some isolation is in-built in the power supply circuits for signaling, track circuits etc., to avoid any possibility of two sources having different frequencies interfering with each other at the junction points).

FAITH IN FUNDAMENTALS

I might as well have captioned this chapter "The Case of the Hijacked Transformers".

This story relates to 1966-1967. The change-over of the Madras Beach-Tambaram Meter Gauge Suburban Section of Southern Railway from 1500 V DC to 25 KV system was done on 15th January 1967, overnight without cancelling a single commuter train. Many may not know that behind that event was an important technical decision, followed by meticulous planning and team-work in execution.

I was a senior Scale Officer in 1966 and was asked to look after, in a leave vacancy, the work of the Dy. CEE in-charge of the Conversion work for a few months. When I took over, the field works had nearly been completed and ICF had already started supplying AC EMUs, which were getting stabled in the Tambaram Yard under AC OHE. An excellent and dedicated construction team was getting to be idle. For, there was a hitch - an item of work

had not been done viz. installation of 33 Booster-Transformers at various locations on the section, which was a prerequisite for energising the section on 25 KV AC. In fact, the transformers were not there. The ship carrying the transformers from Sweden had been hijacked on the high seas (by whom- nobody was certain but there was a suspicion that it was by Pakistan) almost a year earlier. I was shown the file of papers containing the correspondence with the Railway Board, with the ministry of External Affairs, with the Ambassadors of other countries, and so on. But, the file was no substitute for Transformers.

Of course, the idea of using the standard Booster Transformers employed on Broad Gauge Sections had occurred ; but RDSO had clearly said "No" and in writing too.

A little reflection convinced me that RDSO's technical advice was wrong. Surely, a higher capacity (300 Amps.) Transformer could be used in place of a lower capacity one (200 Amps.). In fact, I could have attempted to convince RDSO merely by comparison of the technical data pertaining to the two types of transformers. But tactically, I feared that such an effort might lead to confrontation and could defeat the ultimate objective.

I therefore decided to proceed from fundamentals. We managed to get one Booster Transformer from the Broad Gauge Projects and carried out a simple short circuit test one night using an available power transformer at the Egmore DC traction substation as "power source". The results of the test were used to calculate the impedance values. An equivalent circuit was drawn up. Armed with this data, a detailed technical Note was sent to RDSO, explaining that the impedance of BG transformers as seen from the Catenary System was the same as that of the MG (as seen from the Technical Data furnished) and may be RDSO could reconsider their decision. My CEE who was leaving for Delhi about the same time was given a copy of the Note to pursue with the Railway Board and RDSO.

The idea was practically attractive because a large number of BG Booster transformers were indeed available as "Surplus" at that time on Central Railway, having been received for the Igatpuri-Bhusaval section, which was nowhere near the commissioning stage, as there were a large number of other works yet to be completed.

I was thrilled when my CEE spoke to me from Delhi to say that RDSO had accepted my technical Note. Looking back, I am tempted to think that my Note may have provided just the right kind of face-saving device they needed. Only RDSO's archives can throw further light on this point. The Board had also agreed to divert 33 KV transformers from Central Railway to Southern Railway.

It had taken about a month from the time I conceived of this strategy till we got RDSO's and Railway Board's approvals. Thereafter things moved with great speed and precision in physically transporting the transformers from Central Railway territory to Madras, doing filtration of oil, moving them to the different sites and finally installing them on the structures. Thanks to the fantastic team effort put in by the officers and men of the organisation, the work was completed in a mere one month thereafter.

I had done a short circuit test on a very small transformer in my college days (1952) in the Electrical Laboratory. I could never have imagined that I may have to do such a test in the field on a large transformer, merely for proving that fundamentals can never go wrong. But I do not regret that experience, for it achieved results in no uncertain manner.

It may not be out of place to mention a special feature of the programme of commissioning of the section for AC traction, after the transformers were in position. A detailed programme was drawn up, writing out sequences of operations at the various locations, what each team was to do and when, how to report on telephone commencement and completion of the assigned works etc. Briefing meetings were held during the day and work was done at night. The section was divided into 3 small subsections :-

- i. Tambaram - Guindy
- ii. Guindy - Madras Egmore
- iii. Madras Egmore - Madras Beach

Each Sub section was tried on 25 KV AC, proved and restored back to DC - one by one on 3 nights. When everything was found all right , the final change over to AC over the entire section was relatively much simpler, as there was no extra operation to do for going back to DC as on earlier days.

By 2.30 a.m., on 15th January 1967 the change over operation was all over and 25 KV AC was switched on the entire section, Madras Beach - Tambaram, including the erstwhile steam operated main line between Madras Egmore and Tambaram, known as Third track.

I was present in the Supervisory Remote Control Centre for the 3 nights when the three subsections one by one went through DC-AC-DC changes. On the night on the final change over itself I moved over to the Tambaram Car shed to over-see readying of the new AC EMU's for service. I had bought from the bazar large quantities of sweets and travelling by the first train which left Tambaram at 3.30 a.m., I distributed the sweets to every working party on the entire section. What a pleasure it was to share the moment of joy with those who had made it all possible.

The first EMU train left on schedule at 4 a.m. from Tambaram. There was a ceremony later in the day to flag off the first main line train hauled by AC loco from Madras Egmore.

Almost twenty years later (Oct.1987) my faith in fundamentals again came to my rescue and to the rescue of South Eastern Railway - on a much simpler issue, however. Para-by-para comments of the Chief Engineer cleared by FA & CAO on a Draft para had been put up to me for approval before being sent to the Audit and to the Railway Board. It was a requirement that reply to a Draft para should be approved by GM personally.

The thrust of the Audit para was that although the Railway had received certain quantities of rails sufficient for say X1,X2 & X3 kms of track renewals in three successive years, only Y1,Y2 and Y3 kms.had actually been done, there being a very big short fall in performance i.e. gap between x and y every year.

The draft reply was wishy washy and round about. Some quantities of rails had been loaned to other railways; changes in the audit figures regarding renewals done were called for, etc. It was clear to me that this was no defence; for, all this explanation could not account for the big difference.

I rubbed my eyes in disbelief. Where could all the rails have gone? Surely they could not have disappeared. And the Railway had been crying for input of rails repeatedly. And I had no doubt about the capacity of the Engineers to use whatever rails were made available.

I decided to look at the figures once again. I used my calculator once, twice and thrice. It did not take me long to realise what had gone wrong. The Audit had assessed the kms that could have been done, by dividing the total tonnage of rails received by 52, which is the weight in tonnes per km of a single rail section. Surely, a track needs 2 rails; The division should have been done by 104. When the correct calculation was done, it was clear that whatever renewals had been done tallied very closely with what could have been done with the rails supplied.

The "error" of the Audit was understandable. But, to my mind, it was unpardonable that this simple mistake of the Audit had not been detected by the Engineering and Accounts department, who frame and clear estimates for track renewals literally by the dozen, year in and year out. The figures should indeed have been at their finger tips, so to say. That the simple matter should have been allowed to escape attention from the lowest to the highest levels in those departments baffled me. I called CE and FA & CAO and talked to them. I asked them to discuss this matter with the Chief Auditor so that he could drop the matter gracefully. They must have done so. The case never came to me again.

LEGAL ADVICE

Law is an ass. So goes an old saying. My father was a lawyer; so was my father-in-law. In these circumstances, I can show no disrespect to that great profession. I shall merely narrate an incident of my encounter with an eminent lawyer, on the files of Government of course and leave it to the reader to `judge' how close to Truth this proverb could be.

It was in 1966 that this event took place. I had been asked to look after the work of the Dy. Chief Electrical Engineer (Construction) for a few months on Southern Railway. There was an ongoing dispute for months between the Railway and a Contractor who had executed certain Railway Electrification works about the Railway's liability to pay Sales Tax on certain items. The Contractor claimed that the payment was due to him; the Railway had been arguing that as the supply of the items had been made as part of a Works Contract, no tax would be payable.

It had been decided by my predecessor that as Railway's Legal Department could not render any advice satisfactorily, we should obtain expert legal opinion in this case from an outside luminary of the legal profession. In fact, it had also been decided to whom the Railway should approach for such advice - an eminent lawyer of Madras who had occupied the post of Advocate General earlier with distinction. This person had been sounded and had agreed to render his advice on payment of a consultation fee of Rs.3000/-, a large sum in those days.

It felt to my lot to "process" the case further. I put up a brief Note on the file and took GM's sanction. The lawyer had demanded payment of full consultation fees along with the reference and this condition had also been accepted, while getting GM's sanction.

I remember having gone through 3 or 4 case files containing the Contract and correspondence between the Railway and the Contractor. My DEE had put up an excellent summary of the important papers and had "flagged" them up as usual. (For the uninitiated, a "flag" is merely a small piece of thick paper pinned to the appropriate letter or note on the

file and suitably marked in alphabets or numbers for reference. Oftentimes, the flags are in different colours to reduce the monotony. They stick out of the file in such a manner as to draw attention of the person who has to go through the papers. The art of flagging in such a manner that one flag does not obstruct the flag below it is mastered and perfected by clerical staff in a Government Department over the years)

I made a brief note on the top, listing out the points on which Railway needed expert opinion. The entire bunch of papers along with a cheque for Rs.3000/- was sent to the lawyer's residence.

When the file of papers came back to my desk a week later, I opened the "red tape" with great expectations. The expert advice was contained in a signed Note of four pages in impeccable English quoting extensively from case law on the subject and the decisions in parallel cases from the various High Courts of the land. I can never forget the Master-stroke-the concluding paragraph of the Note which contained the operative part, namely the expert advice for which the Railway had paid the fees.

"Summing up, I would say that while the Railways have a good case to fight, I would not advise them to do so".

A CONTRAST

1969. About 10.00 a.m. on a fine morning. My senior colleague Mr.Sreenivasan and I were on the floor of the Traction Motor Machine Shop in CLW. We were closely examining a few steel castings, some of them machined, and the fixtures used to machine them on the Vertical Borer. There had been some problem of ensuring concentricity between two circular machined surfaces. Repeated rejections were a cause for concern in the production belt of Traction Motors.

In our concentration, we had not noticed the GM coming. It was his voice that caught our attention.

"What are you doing ?" - he asked. He had come close to where we were standing.

"Good morning, Sir. We are investigating into some problem" I said.

That was enough to set him on fire. "That is the problem with you fellows. You seem to be investigating all the time. And you have chosen today, of all days". So saying he walked away.

That was a Bandh day. The Bandh was a near total "success" throughout CLW. In the Traction Motor Machining Shop, only four men were present out of a total of some 200 staff. Of the four who were present, there was a good supervisor and a machinist of some experience. There was no Crane driver. We could not load any heavy part on to a machine or unload it. It was clear that no worth-while production could be achieved on that day. On the other hand, I had been having this quality problem on the machining of the end shield casting. I had respect for my senior colleague's knowledge and ability in anything mechanical. He had a responsibility too, because he was in charge of Inspection and Quality Control. He had agreed to have a look. We thought that there could be no better day than a Bandh day to go into this problem in depth and solve it. The atmosphere was ideal - silence all over and nobody to disturb us.

But the GM seemed to think differently. He wanted us, I suppose, to move up and down in the work-shop, see the few faces and count the heads of whoever had turned up, thrust some work on them, and generally keep a watch that they did not sit idle or go away. He presumably wanted us to enforce discipline without purpose on the only disciplined handful that had turned up, despite threats from their "leader".

Contrast the above with what happened some years later.

It was a Bandh day in 1975. This time it was believed that the Bandh would continue for a few days.

We used to be at our desks by 6.00 a.m., more than an hour earlier than usual, traveling by the office Bus. On the first day we could clear some pending papers, discuss matters that required co-ordination and interaction with one another. I used the opportunity to clear some ideas with the CEE for whom I had nothing but the greatest respect.

A simple lunch - we had carried with us edibles even as we came to work so early in the morning - was over by 11.30.a.m. We had gathered together for a chat, having nothing else to do.

There was a call from the CEE. A few officers were seated in his room.

"Are you doing anything in particular ?", he asked me.

"Nothing, Sir" I replied.

"I thought I could spend these hours usefully to give all of you some idea of Computer Programming in FORTRAN. I have learnt this language and have been practising it for sometime. It is a useful tool for engineers. In some three or four sessions, two hours each, you should make good progress". He said.

We started then and there. The CEE was our Guru and we were his disciples. We had two sessions on successive days. When the third was due, the Bandh was Off and we were back to our grind once again. Needless to say we never had again an opportunity to continue the study. But then this person had taught us something valuable when we would just have done nothing but idle gossip.

What a contrast, I thought, with the GM who had been unhappy with me for doing useful productive thinking on a Bandh day.

THE NOMEX-MICA WRAPPER - A DAY'S LABOUR ACHIEVES A BREAKTHROUGH

Anyone who has seen manufacture of armature coils for traction motors will no doubt be familiar with the Nomex-Mica Wrapper, which is used as the basic coil insulation for the slot portion. The wrapper is applied over the coil sides and there after the coil sides are moulded to shape, under heat and pressure.

The Nomex Mica Wrapper concept came to India just over 20 years ago (1970), with the TAO-659 Traction motor collaboration from Alsthom, France. Although the product is now available with relative ease and in good quality and is used extensively not only for the TAO-659 motor coils but for many others as well, yet when it made its first appearance there were quality problems that almost drove the motor manufacturer to despair.

I was Dy CEE then (1971) in the Traction Motor shop of CLW. The Wrapper, which was an imported item supplied by Alsthom, used to come in big sheets which had to be cut into the exact wrapper size and used. One fine morning, the coil manufacturing section reported that some of the Nomex-Mica sheets had developed wrinkles on the Nomex and the coils were failing in large numbers due to dimensional deviations and sometimes in dielectric tests too. The rejection rate was unacceptably high. I had a look at the materials as received and kept in the air-conditioned store. Even newly received material, airlifted from France, showed up this defect. It was obvious that production could not be carried on satisfactorily, with this serious handicap.

Fortunately, we had taken up the task of indigenous development of this item with a Calcutta supplier; but we had just received a report that the first lot of samples produced by the firm had also failed to meet the prescribed quality standards, a major problem being the development of wrinkles. An impasse had been reached.

Under the Collaboration, we did not receive the knowhow for the manufacture of the wrapper itself, although its application and testing methods were known.

I was determined to get over the problem. I was reasonably hopeful that indigenous manufacture rather than importation gave us a better prospect of getting material of proper quality. The basic Nomex sheet -Type 410-2 mil thick imported from DU Pont was available in the country and there was not much to go wrong with it. Mica is cent per cent Indian and the bonding/ laminating silicone varnish (imported from France) was available. I took a morning train to Calcutta and was at the manufacturer's premises at DumDum by 11-30 am.

We did quite a few trial sheets following the process the manufacturer had chosen to adopt. After an hour or so, wrinkles (minor in nature compared to what I had seen on the imported material in our stores) started appearing. I had noticed that a mild preheating of the Nomex Sheet was done before the laminating process, presumably to drive away moisture. I said " Let us do some, without preheating". And sure enough, the wrinkles did not appear. Through trial and error, the ideal duration for the varnish applied on the sheet to cure in air was determined, so as to provide the right amount of tackiness for laying the mica. A light coat of varnish was again applied over the entire mica surface.

It was then that the idea of using rectangular book form mica of the chosen thickness (2 mil) instead of mica splittings of irregular shape occurred to me. Perhaps I had seen this somewhere- I do not remember, for sure. The size was decided. The manufacturer cooperated. The mica pieces were laid at an angle as shown in the figure. I felt that such an arrangement could give a greater probability of obtaining uniform thickness of insulation and consistency in di-electric strength. A few sheets were made with success and they met the quality requirements regarding di-electric strength and thickness. There were, of course, no wrinkles. By the time I finished the experimental work, it was 4 pm.-just time to catch the Coal-field Express train to Asansol, for Chittaranjan. I carried a few sample sheets with me.

CEE/CLW had dropped in at the manufacturer's premises for an hour or so, when I informed him of my line of thinking. He encouraged me with a smile and left.

The next day, a couple of coils were wrapped and moulded with the sample wrappers I had brought from Calcutta. The test results on the coils were satisfactory. The workers were happy to see a wrapper delivered to them in the final size, with neatly arranged mica and with no wrinkles.

My decision not to do pre-heating of Nomex was taken primarily to eliminate wrinkles. There were persons who expressed reservation because moisture could present a problem. My expectation was that in the subsequent process of "Heat Press" in the moulding stage, the moisture would certainly be got rid of.

In due course, CLW depended less on imports and concentrated more on getting the item from sources within India. A technical specification was also drawn up.

During one of my visits to the same DumDum factory many years later, the manufacturer showed me the notebook in which I had written down on that eventful day the different steps of development through trial and error and the various test results obtained. He had become a regular supplier of Nomex-Mica to CLW and Railways and had decided to preserve the notebook as a reminder of that all-important day's work.

Nomex-Mica wrapper has become a standard product today. A variation, in recent times, is the use of Mica-Paper instead of Mica. Many more manufacturers have entered the field. I do not know what process is actually being followed at present. Whether we have since come to know the details of the process adopted by manufacturers abroad is also not known to me. I would not be surprised if they have also fallen in line with what was evolved successfully in India.

Necessity is the mother of Invention, they say. It was the wrinkles on the imported sheets that pressed us to go ahead with the task of indigenisation urgently.

That was certainly a great day for me. For those who make and use Nomex-Mica wrappers routinely today, this story about the origin of the product should be of historical interest.

THE FIRST KAPTON COVERED CONDUCTOR IS MADE IN INDIA

Kapton is now a house-hold word with Railway Traction Engineers, Supervisors and staff connected with the manufacture, rewinding and repairs to Traction Motors. A product of DU Pont, USA, this superior insulating material is extensively used in Traction Motors. Yet until twenty years ago, it was unknown in India.

The first Kapton covered conductor ever to be made in India was at the works of Wandelside National Conductors (WNC) Pune, against a CLW order for a small quantity of 600 Kg. I had piloted the placement of this order and did the Acceptance Inspection of the product at Pune for despatch to Chittaranjan. I am informed that the factory proudly remembers that first success even today. I too remember my association with this development effort, not so much for any technical contribution as for the managerial effort behind it.

It was in 1970 when I was in CLW that I came to know about Kapton. I happened to see some literature of DU Pont, USA, about various type of Kapton films (F,H, etc.) and their properties. DU Pont claimed that according to M.Jouy, Design Engineer of Alsthom, France, Kapton is the insulation which would provide excellent reliability with the possibility of increasing conductor copper size leading to higher power output for the same size of machine ; or if we choose to retain the same copper size, a smaller machine for the same output. Alsthom were our Collaborators but we had not been told by them about this development. The technology that had been passed on to us was based on use of asbestos-covered conductor for armature coils. We were not very happy with this material as it was hygroscopic and processing was not so easy. We had also heard that asbestos based materials may go out of use in future as asbestos was considered to be carcinogenic. Above all there appeared to be no possibility of indigenisation. We had on our own been trying glass-covered

conductors (INCAB, Tata Nagar assisted us with this development) and found that it fared as well in the production belt as asbestos covered conductor. Alsthom had seen our efforts but had said neither YES nor NO to this development.

Inter-turn insulation failures on armature coils were not uncommon with glass covered or asbestos covered conductors at the various stages of testing in the production belt. I thought that Kapton could provide the answer to our problem.

I had met Mr. Jouy in France when I was there on a brief visit in September 1969. When he visited India later, I consulted him regarding the use of Kapton for the TAO-659 motors. Mr. Jouy did not encourage the idea. Kapton was a "difficult" material to handle and as we were still to settle down to manufacture in CLW, he would not advise us to go in for Kapton.

Thus there was no possibility of our getting either the material or technical advice from the Collaborators regarding Kapton covered conductors. I decided to pursue indigenous development. At a chance meeting with an Engineer of WNC, Pune I gathered that he was keen in this developmental effort. For the first development order of 600 Kg. sufficient for about 6 armatures, I took a decision to use 66-2/3 % lap of Kapton film 150 F019 (i.e. Kapton 1 mil with adhesive teflon 1/2 mil on one side only). From the Literature that I had come across, 50 % lap of same material appeared to be standard but I had decided to specify 66-2/3 % lap to provide a better margin; and I was taking this decision on my own.

The material was ready in a few months. I went to Pune for inspection. A kind of heat-sealing process had been adopted as the copper conductor passed through a vertical tower and the Kapton-teflon film got lapped around it. The product looked good. There was no standard specification at that time for Kapton covered conductor. An IEC specification was in the draft stage. However I did a few simple mechanical bending tests and few Dielectric tests under various conditions, wet and dry. I was satisfied with the product, accepted it and authorised immediate despatch by road. Unfortunately there was some problem on the way ;

the material was almost lost ; but somehow, we managed to get it at Chittaranjan after 4 months.

And when it arrived, the material was widely welcomed in CLW shops. Armatures processed behaved much better in the production belt at the various stages of dielectric testing. But it took many years before the Kapton covered conductor has come to be in regular use in CLW. BHEL, a much bigger manufacturer of Traction Motors introduced Kapton even later.

In my tenure at Kalyan Loco Shed, which followed soon after my assignment in CLW, reliability of Traction Motors was "Problem number one" and the Shed had already started thinking of using Kapton for rewinding of armatures of EMU and loco motors. My CLW experience helped formulate the detailed specifications for procurement and processing placement of orders for the Kapton insulated conductors of the different sizes required for all the different types of armatures.

For the Traction Machine Workshop project, Nasik Road, which was my next major responsibility on Central Railway, I took on myself the job of not only directing and managing the construction activities but also the workload of planning and procurement of the raw materials and components required for winding work, when the Project would be completed. In the first list of materials drawn up for this workshop, I catered for fifty percent of all armatures being done with Kapton conductors and fifty percent with glass braided conductors. (Initially I had proposed to go in for Kapton cent per cent. When I shared my thinking with Mr. Hattangadi, the Director (Standards) Electrical RDSO at that time, for whom I had the greatest regard, he neither said YES nor NO to the idea ; for he sincerely believed that our problems of reliability were not all attributable to the use of glass or asbestos insulation and that while Kapton would help, we had to take care of other problems as well and overcome them. It was in deference to his line of thinking that I toned down Kapton procurement to fifty percent eventually)

The slot insulation scheme for each type of Traction armature was drawn up with care and the conductor size, different from whatever was in use till then, decided. A feature that was added by me was the use of a Nomex slot liner for the full length of the slot, as I could find the space for this liner in the insulation system design because of thinness of the Kapton film. The liners were thus included as part of the first Material Schedule drawn up for procurement for TMW. in 1980. I believe that use of Nomex slot liners has since been adopted by BHEL and many rewinding shops. I was pleasantly surprised to see in 1984 that the designs of many motors offered as part of the Thyristor locos from Japan and the Continent did incorporate such liners.

It is a matter of satisfaction that Traction Machine Workshop, Nasik Road has over the years switched over to 100% Kapton; that the processing has been perfected to turn out armatures with a high degree of reliability; that CLW and other Railways have also followed suit, with excellent results.

I wish to throw up a few ideas for the future:-

(i) The 66 2/3% lap was decided by me at the first stage of trial and development of Kapton covered conductors, to provide a higher safety margin. I find that this specification has come to stay. The world over, they continue to use 50 % lap. With so much experience behind Indian Railways, I believe that controlled experimentation and comparative evaluation of 66 2/3% lap and 50% lap should be done now to decide whether it is necessary to continue with 66/3% lap or to go over to 50% lap and effect some savings.

(ii) I had expected that with the use of Kapton covered conductors, the rejections in the manufacturing belt, at least at the coil stage, would be reduced to ZERO. This expectation has not materialised. While the rejections have come down appreciably, they have not become ZERO. I believe that a ZERO defect state is achievable without doubt. It requires only a change in philosophy. Those in-charge should develop a sense of dissatisfaction with the extent of progress made so far and of determination to identify the underlying problem by treating each case of coil failure as UNACCEPTABLE.

(iii) The film 150 F 019 was the standard then and I suppose it is the standard now. ASEA, Sweden at one stage (1984) proposed that in their motors they would be using 200 F 919 i.e. Kapton 1 mil thick with teflon 1/2 mil thick on both sides. The use of this film, they claimed, would lead to better bonding between conductors. Perhaps ultimately 200 F 919 with 50% lap may prove to be better than 150 F 019 with 66 2/3% lap. Here again, discussions with manufacturers and experimentation is called for, before decisions are taken.

(iv) Kapton film is a proprietary product of DU Pont USA. They may not part with the know-how for manufacture in India. BHEL and ISRO, Trivandrum had shown interest some years ago of developing a film indigenously, which would be comparable to Kapton. I had seen some trial samples with ISRO. In the long run, effort at indigenisation is bound to do good. Perhaps, the National Chemical Laboratory at Pune may be able to help. The Indian Railways have to take the initiative, as they will be one of the major beneficiaries, if the indigenisation effort succeeds.

HEY JAGDISH! (OH, GOD!)

When I took charge of production of Traction Motors in CLW in April 1968, the assembly of the MG 1580 Traction Motors using imported armatures had just started. Thanks to the energy and capability of my predecessor, a good foundation had been laid, in areas of processes, tooling, arranging raw materials, training of workers etc. But we had a long way to go.

The pressure really came on, when the stock of imported motors got used up and the locomotive assembly shops started depending on CLW built motors for locomotive production. And, within the TM shops, stock of imported armatures was dwindling and we were still struggling almost every day with a number of problems on materials availability and of poor quality of the steel castings delivered by the CLW steel foundry. Piece work incentive scheme had not been established and the workers were going slow. And we had to start preparatory work on the manufacture of the new series of Traction Motors viz., TAO-659.

With some rare exceptions, the CME's and GM's were primarily interested in production and very rarely with my problems. I used to think of them as "number takers"- which was the operation they were doing in their routine visits to the TM shops.

It was a struggle day in and day out. But we would not give up. It was a Collaboration with the French Firm, Alsthom, in operating which, no foreigners were ever posted in the Indian soil right from day one and we were determined to keep it as such. At times, deviations from stipulated tolerances and test standards had to be accepted; otherwise production would be hit badly "Relaxations" as we used to call them had to be obtained, if we were convinced that

- i. we could not have done better at that point of time
- ii. the deviations were such as would not affect performance or safety, and
- iii. we were taking steps to improve the quality and to avoid the particular type of problem.

In getting relaxations, the production team had to contend with three Jagdish's in those days.

Stage I JAGDISH CHANDRA - The SEE/Inspection and Testing, a reasonable and practical person, who could appreciate the ground realities but was firm on basics and essentials.

STAGE-II JAGDISH UPADHYAY - The inspecting officer on the electrical side from RDSO, stationed at Chittaranjan. This person was somewhat more rigid and did make things difficult for the Production, sometimes on non-issues but mostly on major areas where he wanted CLW to concentrate on quality improvement in the long term interests of the Railways. Relaxation would come eventually in most cases but by then the production team would get so tired in offering justification, clarifications and explanations that one felt at times that it would be far better and perhaps easier to adhere to standards than to spend one's breath in arguments.

I believe that this must have been the reason for his attitude too, although he would not openly express it in so many words.

STAGE - III. JAGDISH GUPTA - Jt. Director Electrical (RDSO), who visited Chittaranjan once in a while and picked holes in most of what was attempted to be done. He was theoretical in his approach and difficult to argue with. My arguments with him that BHEL was shown favoured treatment by RDSO in enforcing standards were usually brushed aside. Our relief was that we felt his influence only rarely on the production effort.

There were rare occasions of desperation when I used to console myself that there was, above all of them, one supreme JAGDISH (GOD) who was there to run the show. I don't think I gave vent to this feeling in public but I have jocularly remarked on this coincidence of names in private conversations amongst friends who knew me well and who would not mistake me.

Talking of the role of the supreme JAGDISH in the production effort, brings to my mind a General Manager who used to ask me "Natarajan, have you prayed today at the test Bed?" He was referring to the fact that there were cases when some Traction motors after passing through all quality control stages used to fail at the very last stage just before despatch on an obligatory di-electric test of 5100 volts AC for one minute. The collapse would occur sometimes very close to the test voltage and on some occasions even at the test voltage after 30 to 40 seconds. So much of production effort would go to waste, necessitating rework. Fortunately such incidences were not many- less than 5% on an average.

But I cannot forget the two days when four traction motors failed successively one after the other, at the last stage of di-electric testing at 5100 volts AC. The Chief of Inspection was worried. I was of course desperate and despondent. We sat down together to see what had gone wrong. Imagine our anguish when we discovered that the motors had been blameless but merely that they had been subjected to a very much higher voltage (nearly 10,000 volts AC) during the test, thanks to a minor defect in the testing apparatus.

One of the diodes in the Bridge circuit feeding the volt meter had failed and open-circuited, with the result that the meter was indicating only about half the voltage that was actually being applied. The operator had failed to notice or pay attention to the fact that he had advanced on the "variac" much more than normally. From that day, mechanical stoppers were introduced in all the Dielectric testing sets on the shop floor to prevent inadvertent advancement beyond the usual range necessary for the testing done in the concerned section.

A famous saying that I used to recall to my mind ever so often was "you cannot test quality into a product". One has to achieve Quality only through attention to design, processes, workmanship, materials, tooling etc. at every stage. No amount of testing can be a substitute for the above effort.

The above was of course an extreme case where lack of quality in testing destroyed the product itself.

FOOT NOTE: Jagdish Chandra retired in 1991 from the position of General Manager, Railway Electrification, Allahabad.

Jagdish Upadhyay rose to occupy the highest position an Electrical Engineer can hope to reach in his profession on the Railways. He retired as a Member (Electrical) Railway Board in 1994.

Jagdish Gupta retired some years ago after serving as CEE/CLW and Director (Traction Installations) in RDSO/Lucknow and Adviser (Electrical) Railway Board.

THE USEFUL ROLE OF ODD AND EVEN NUMBERS IN THE DESIGN OF EXPERIMENTS

Anyone who has designed experiments or Test Schemes will agree that comparison of results under two alternative ideas would be valid only if:-

- (i) The number of pieces/products undergoing the test is significantly large in number.
- (ii) The number of pieces under each alternative scheme is about the same.
- (iii) Except for the particular predetermined variation imposed by the designer of the Test Scheme, the product should be exposed to all other environmental conditions in a similar manner. In other words, there should be no 'bias'.

I have believed that groupings based on odd and even nos. provide a simple and easy means of ensuring the requirements.

When I was Dy.CEE/CLW in-charge of Traction motor shops, my SEE mentioned that at the 4 or 5 stages of dielectric testing of armatures in the winding belt, there were quite a few failures: that these were occurring perhaps because the test voltages were unnecessarily high (although laid down by our Collaborators); and that we could afford to reduce the test voltage by 0.5 KV or so, without affecting the quality of the final product.

I directed that all the armatures having odd numbers as their serial number should be subjected to a particular test scheme and that those having even numbers as their serial number to another, the only difference being 0.5 KV in the test voltages at every stage. At the end of a couple of months, we went through the records and discovered that there was nothing much to choose, as the incidence of failures was about the same in both the groups. We came back to the Collaborator's advice for all armatures, as before.

In 1985, some fifteen years later - when I was CEE on Southern Eastern Railway, during one of my inspections of the Bhilai Electric Loco Shed, I chose to adopt a similar approach to find out whether repeated attention of the delicate English Electric make relays on WAM-4 locos really helped reduce failures. I said - check and do your normal inspection and maintenance activity on the relays on all even Nos. of locos. and do nothing on the relays on odd Nos. of locos. I also gave them an aid to assist to remembering which locos to check and which to leave unchecked. Everyone nodded `yes' - they had understood the instructions.

About 3 months later, when I visited the shed, I brought up this subject again. I was on a locomotive that had come to the shed for some attention. Everyone confirmed that instructions regarding relays were indeed being followed. But when I asked them what they would do on the particular loco on which we were standing - check or not check - they were not to sure. Everyone was looking at the others for inspiration.

The "AID" I had given them during my previous inspection was the word "Easy" - "Easy Enough" I had said. " Easy stands for EC -- E for Even and C for Check. Even Nos. of locos to be checked."

I had learnt a lesson. It is not only necessary to make your instructions clear and easy to remember. It is also necessary to recheck and follow up compliance until they become part of the system.

I STOOD UPON A TABLE FOR HOURS

The Member (Mechanical) and Financial Commissioner were expected to visit the Traction Motor Shops that morning. But I sensed some thing wrong in the atmosphere of the TM Shop by 9.30 a.m. That was pay day. The payslips printed out by Computer had been distributed. The staff of the armature coil section were peeved that there was something wrong. The piece-work bonus had not been correctly worked out. Murmur started and soon shouting followed. The disease was slowly spreading to adjacent shops as well. that was the "culture".

I did not want the VIPs from Delhi to visit the shops, in that state. No useful inspection could be carried out; on the other hand some physical harm could result, if things went out of control. Where reason had vanished, anything could happen. I rushed to the entrance gate and stopped the VIPs' cars. GM and CME were with them. I asked them to go back. They saw my point and went to the Administrative office.

Ordinarily the first shift in shops closed at 3 p.m. and on pay day, the staff collected the pay in cash from the different counters and went home. But on that day, staff of all the three shops of the TM group refused to take their salaries until the mistakes in the particular payslips were corrected. I argued with them, I pleaded with them, promised that the affected persons' cases would be examined speedily and that supplementary payment would be arranged within a couple of days. Nothing worked. They were adamant. I had not gone home for lunch break. There was a steel work table near the Vertical Boring Machine. I stood up on the table and tried to pacify the staff. I thought I had a better chance of being seen and heard from that position. A crowd had gathered around. The staff continued shouting. There was no personal abuse or attempt to hurt me. I just stood there and waited, putting up as pleasant a face, as I could. A stage was reached when I could speak no more and plead no more. I had no energy left. Throughout, there was no show of force from the management to discipline the crowd.

It was around 6 p.m. when the staff relented. They had become tired too. My patience had tried them, perhaps. Everyone took his pay packet and went home.

I was free by 6.30 p.m. and went over to the Administrative office. The meeting of the Board members with GM and other HOD's was on. They enquired about my condition. Of course they must have been receiving frequent reports about the situation in the shops. I told them I was well. They did not want to discuss any subject with me. I went home. Thus ended a day of tension.

A PRODUCTION CRISIS AVERTED

It was one of the many difficult days during my tenure as Dy.CEE in charge of Traction Motor Shops in CLW. I was travelling in a crowded First Class train compartment on an early Sunday morning from Asansol to Howrah. I don't now remember why I chose that particular train or why I travelled by First Class instead of by Air-conditioned compartment. I certainly was in a hurry to reach Calcutta.

With me was a card-board box containing Railway material. I had kept it in the corridor - it was too bulky to be brought into the compartment. I had to look it up ever so often in the journey to make sure it was intact and safe. It was indeed a 'Precious' cargo - valued some Rs.50,000 or more. It contained about 3,000 Micanite Segments (over ten motor sets) imported from France for the manufacture of Commutators for the TAO-659 motor in CLW Traction Motor Shops. These segments were all unsuitable for production, as their thickness, although within the tolerance limits specified, was uniformly low (1.21 mm to 1.22 mm i.e. bordering on the lower limit of the tolerance range (nominal thickness specified was 1.25 mm).

The segments used to come to CLW in packs of some 30 or 40 numbers. Each pack contained segments belonging to a particular thickness classification like 1.21 ; 1.24 ; 1.28 etc.- with in the tolerance range specified. During the manufacturing process, we had to use segments of different thickness and distribute them along the circumference in such a

manner that a commutator of the correct dimensions resulted after the various seasoning operations under "heat press". We had to keep in close touch with our Collaborators and suppliers viz. ALSTHOM/France and tell them from time to time through cables etc. as to what quantities are required, in what sizes, to match those available in stock at Chittaranjan. Yet, there would be problems of production from time to time arising from mismatching.

This was one such occasion. Production had virtually come to a stop. Most of the segments available belonged to the lowest thickness classification and using them would result in the internal diameter of the commutator going below an acceptable minimum limit. There was no immediate prospect of further supply from France. We had taken up indigenous development with a firm in Bombay but it was still a long way to go.

A thought occurred to me. Why not paste a single Pure Mica film of appropriate thickness (1 mil or 2 mils) on the segments to build up the thickness required. It was to translate that thought to immediate action that I was on my way to Calcutta.

At Calcutta, a manufacturer of Mica Products agreed to help. It was decided that book-form Mica of the appropriate thickness should be pasted on the segments using an imported Silicone Varnish, which was available. The lot of thin segments that I had carried with me was handed over him and in about a fortnight we received the built-up segments of satisfactory thickness at Chittaranjan. The production got going again. There was no hitch or technical difficulty in the process of commutator assembly or motor manufacture.

However. When I took over the maintenance of DC locomotives at Kalyan Loco Shed in Central Railway a few years later, I came across a very serious problem on the commutator Mica of TM 4939 AZ Traction Motors built by BHEL. (I have dealt with this in detail elsewhere in these Reminiscences). With that experience, I have sometimes wondered if similar problems were experienced on the particular CLW built TAO-659 motors sent out with built-up Micanites in their commutators. These Motors must have completed about 20 years in service. As the serial numbers of the armatures having commutators with built-up micanites were recorded in CLW and list of such armatures circulated to Railways, it may be not be

difficult for CLW and the Railways to verify how those motors have behaved in service. If they have done well, I will have the satisfaction that the unorthodox solution that was attempted not only helped to keep the production belt moving in CLW but also that it did not cause any special problems of unreliability in service. If on the other hand, the Motors failed badly, I can only say today, " Sorry. I took a risk. I regret that decision '. What more can I do now?

AN ARMATURE WINDING IS X-RAYED AND WHAT A REVELATION

A day in September 1971, a day that Mr. Nouvion, that giant of AC Traction, visited the Traction Motor Shops of CLW is truly unforgettable. For, his visit precipitated one of the most momentous decisions in the history of a AC Traction in India. I am referring to the decision to re-design the armature winding of the TAO-659 Traction Motors, which form the largest fleet on Indian Railways today.

Credit should go first to the JDIE/RDSO and his inspectors for spotting a problem and highlighting it ; although, at that point of time, to people like me in-charge of production, their discoveries were annoying, as they caused holdup to production of motors in the belt.

The "evolutes" of the armature coil in the finished motors did not appear to be quite normal but somewhat distorted. The planes of the "evolutes" instead of being radial were found to be slightly inclined. The JDIE and his inspectors detected even the tiniest of gaps at the bottom of the "evolutes" by inserting feeler gauges, to prove their point. And when this was pointed out on motors which had passed all prescribed tests and were ready for despatch to the Loco assembly Shops, it was indeed calamitous.

Alsthom, CLW's Collaborators attributed the problem to lack of care in the manufacturing process in CLW . They asked us to try Glass banding, instead of steel banding ; and despatched two of their winders from France to help us out. We did not try to defend ourselves but gave the Collaborators a long rope. The armatures produced by the French "experts" also could not pass the watchful eyes of the RDSO inspectors.

Just about that time, there were reports from the Railways that a few armatures, both imported from Alsthom and made by CLW had failed in service due to "band burst".

The production of motors in CLW, which was just then in the process of being built up, suffered a serious setback due to the rejections and problems at various stages including final stage of despatch. With adverse performance reports coming from Railways, we in CLW decided that we had had enough ; and high lighted the matter to the Railway Board. A high level meeting took place in Delhi with representatives of Alsthom. Mr. Chalvon, Chief executive of the French Firm was there with his engineers and with Mr. Nouvion. The preliminary discussions over, it was decided that the experts should have a look at the problem on the shop floor. We were all in Chittranjan late next afternoon.

M. Nouvion was apparently a great believer in "seeing" things. Next morning he visited the TM Shops. I took him around. He must not have taken more than half an hour. He instructed that an armature from the production belt should be sent for Xray and went away.

I could not fathom why he had made such a strange request.

That afternoon, when the Xray picture was seen, it was a revelation. It was clear that the windings had collapsed under the pressure of banding during manufacture and that the conductors within the coils had been displaced with respect to each other. M. Nouvion showed the Xray to the Alsthom Engineers and gestured as if to say "you have to accept defeat". The Alsthom team stated that the matter would be discussed further in Delhi. And we lost no time, reaching Delhi in a couple of days.

That was a historic meeting in the Railway Board, the second to take place that week. Alsthom proposed a change in design. The conductor copper section of the main winding would be increased and the number of conductors per coil would be reduced to suit. There would be no change in the equaliser design. They called the new design an "improvement"; but agreed to take back all their armatures and return them to India after rewinding then in France to the new design, free of cost to Indian Railways. They would supply to CLW the

manufacturing drawings and process sheets for the new design. They agreed to subject prototype armatures rewound to the new design in their Works to special overspeed tests to prove that the new design would be free from the problems of the type encountered by Indian Railways. They would also supply some materials and toolings for CLW manufacture. It was an indivisible, total and comprehensive deal. The protocol was signed at the end of the meeting by the French Firm and Indian Railways.

On the evening of the X-ray inspection, and before we took off for Delhi, Mr. Jouy the Chief Designer of Alstom had a chat with me. He said that while the solutions would be spelt out in New Delhi, the problem had arisen partly due to his over anxiety to produce a design which would be par excellence in Commutation. While he had succeeded in his effort, he was sorry however that from the point of view of mechanical strength and rigidity, the design had shown some weakness. In short, while the design was "Electrically" top class, it had been seen to be "Mechanically" not good. He sounded confident of producing a design which would meet both requirements satisfactorily.

The rest is history. The new design was successful and has come to stay. The production in CLW, which has dipped in 1971-72 to an all time low of 70 motors (some of them of doubtful quality) picked up to 500 annually in later years. Of course, many other improvements continued to be made by CLW, Traction Machine Workshop, Nasik Road and Railways to increase reliability further; but the basic conductor and coil design has remained the same.

The above experience with the TAO-659 Motor problem and in particular the example set by Mr. Nouvion helped me in identifying the cause of a chronic problem on the 253 BX Traction Motors of BHEL on AC EMU services, some ten years later. At that time I was Director (Standards) Electrical, in RDSO. The problem was the breakage of copper conductors of the equaliser winding. Only an hour of inspection in the winding shop of BHEL/Bhopal was enough to convince me and the BHEL management that the problem arose not from bad track, bad maintenance or bad operation on the Calcutta Railway as BHEL had been proclaiming all along but clearly due to lack of quality in manufacture, in two areas :-

(1) The equaliser winding was not consolidated by application of putty.

(2) The band tension and the band width were not being controlled, even to conform to their own process specifications and drawings.

(It is pertinent to record here that much to the discomfiture of BHEL, the disease spread to Madras area also soon after, as if to prove the point that territory had nothing to do with the problem but that it was the manufacture which was at fault. In due course, BHEL improved the process in the areas pointed out; but even today, due to other reasons of basic design, the 253 BX motor is not performing satisfactorily on the AC EMU services.)

It is necessary to look at one particular aspect of the above case of the TAO 659 motor redesign. While Indian Railways certainly suffered, there is no doubt that Alsthom also paid a price. To take back some 200 plus armatures to France and rewind them was no simple task. It must have cost them good money and effort. And you cannot keep such a transaction away from the eyes of competitors and prospective customers. To some extent, it was thus a prestige issue. Yet, M. Jouy continued with Alsthom as their Chief designer and from all accounts continued to be respected. There was apparently no cry for his blood.

In 1964, I had come across a similar experience in the Power Transformer factory of Mitsubishi Electric in Japan. A number of giant-size transformers costing crores of Rupees had failed, one after the other at the final stage of manufacture, in Impulse test. I was told by an Indian friend, who was taking me round that the Design Engineer had tried a new idea to save money, but the idea did not quite work the way he had expected. The transformers, I noticed, were being opened and modified, as if nothing had happened. At any rate I could not see any commotion on the shop floor.

The above was perhaps second-hand information and experience in a sense. I was myself witness to another instance in the same year in Japan. The first YAM 1 locos (Metre gauge electric) had been built and were almost ready for despatch to India, in the works of

Mitsubishi at Mihara, Japan. I was a trainee from Indian Railways. I noticed as I was walking around the locos, a strange contraption at the axle box in the form of a tiny spring pulling the brake gear into the correct position. I had not seen it earlier. When I asked the Chief designer Mr. Yamashita a simple question to ascertain facts, his face turned red. He said "Every-body makes mistakes". I had hurt him by my question. It later transpired that some mistake had been made in the design calculations for brake-gear, which was discovered only after all work had been completed. The important point was that the same Engineer was able to produce a modification to get over the problem and that the factory was able to manufacture the various items and provide them-all in one day. And the Engineer continued with the company in the Design department for many years.

I can go on like this, recounting many more examples. This, I am sure, must be the experience of many others who have had occasion to deal with Engineers from other countries at close quarters.

Will we in India ever learn to be more rational in our attitude towards human failures and successes, whether in the field of Public Sector management or even in sport and other fields?

OVEREMPHASIS CREATES PROBLEMS

In our anxiety to present a point, we do at times overstress its advantages. This could lead to difficulties later. Two illustrations - with one of which I was very much concerned - are given below. Before I describe them, let me at once state the lessons that I learnt from these experiences :-

(1) If results can be achieved without elaborating a point, resist the temptation even to mention it. This is important in Government work, particularly when you propose to put the point down in writing.

(2) While bargaining or negotiating, keep an escape route so that even if you fail to strike the deal that you wanted, no harm comes to you as long as a deal is made and it is reasonably satisfactory. This again is important, if you have chosen to commit anything to writing.

Let me illustrate item (2) first. The indiscretion committed in this case led only to "pin prick" from the Audit and the matter was resolved after discussions with them. Yet, here was a case where the executive concerned should have been commended, instead.

The matter related to the settlement of Electricity tariff for Railway Electrification on Southern Railway. The Electricity Board had offered a two part tariff, subject to a ceiling on the overall rate per KWH - say X paise. It so happened that for many valid combinations of Energy consumption and Maximum Demand, it was the ceiling which would really apply. X was a fair offer, considering the Board's prevalent Tariff to other customers. But the CEE of the Railway felt that he could do some bargaining, to beat it down further. He collected with special effort, statistics and internal calculations of costing of the Board for Power generation, transmission etc. by deputing chosen staff to the Board's power house, offices etc.. Using the data so collected, he sent a letter to the Electricity Board to say that only upto(X-3) was a reasonable ceiling. The tariff ultimately settled had an overall ceiling lower than X but higher than (X-3). If I remember right, it was (X-2) paise per KWH.

It is possible that but for the CEE doing so much home work, the reduction from X to (X-2) may not have been achieved. Yet the Audit took up the issue and pointed out that as the Railway had, after collecting relevant data, itself been convinced that higher than (X-3) was unreasonable and had stated so, the rate ultimately settled of (X-2) was unreasonable and that therefore the Railway would continue to suffer losses on this account for years.

A lot of explaining and convincing had to be done to persuade the Audit to drop the case. But a little reflection would show that the Audit would not have taken up the case at all if either the bargaining point had been made across the table during discussions with the Electricity Board or in case it was felt that only a letter in writing would extract some concession from the Board, the letter had been drafted in such a manner that it was not so

forthright or specific as to what was reasonable and what was unreasonable. The English language abounds in phrases that are a great help in such situations!.

I had no part to play in the above matter. I was only a witness to the agony and indignation that the CEE went through, which was totally avoidable.

I would for one think that deputing persons to go into details of internal coasting of other organisations is "unethical" and uncalled for in Government work, even though intentions are honourable.

The reader may ponder this point and draw his conclusions.

Case (1) relates to a much bigger problem and I was very much in the thick of it, as Dy.CEE in-charge of the Traction Motor Manufacture in CLW. I remember vividly the day in Calcutta when the Tender Committee proceedings for the purchase of certain Silicone Varnishes for the first time from firm V-agents in India for RP, the foreign manufacturer were being drawn up. Until then, we had procured for quite a few years the same varnishes through CLW's. French Collaborators under the Collaboration Agreement for the manufacture of Traction Motors in CLW. My dynamic colleague from the Store department, who was co-member on the Tender Committee told me:

"Sir, why are you hesitating ? You have taken the initiative and have for the first time been able to find a source who can supply us the same products at 50% of the prices we have been paying all along. Why not emphasise this achievement in the Tender Committee note ?"

The Stores Officer's view prevailed. I did not argue very much as I was keen that the order on firm "V" should be placed quickly. If the first supplies were satisfactorily made and there were no technical or commercial problems, that could be beginning of a new business with firm "V" in preference to the Collaborators, for future requirements. And the TC note was signed in the form that the Stores Officer had wanted.

That became the genesis of a Factual statement, a Draft Para, Report of Public Accounts Committee, Arbitration case and so on, one leading to the other, which continued to haunt CLW administration for several years. The defence in the Varnishes case that

(1) We had to rely on the Collaborators quite a lot technically and commercially in the early stages of manufacture.

(2) We had made efforts on our own to find out if an agent existed in India for the overseas supplier but had not succeeded. As soon as we came to know that firm V in India had started representing firm "RP", we had obtained prices and settled a direct order expeditiously, etc. was only partially and reluctantly accepted. There were inquiries into various aspects of purchase from the Collaborators for a number of other items as well - all of which caused a lot of harassment and diversion from productive work ; there was on the other hand, no appreciation of the efforts made honestly, persistently and consistently over the years to go away from the Collaborators for the procurement of imported materials as and when we came to know that the same or similar items could be purchased elsewhere at lower prices without exposure to undue risks on technical performance, warranty obligations etc.

Of course, a lot was learnt from this experience - however enervating and exasperating it was to those who carried on their shoulders the responsibilities to set up manufacture and deliver the goods in good time. Had the TC note for the Varnishes not made a specific mention of the achievement, there would have been no agony, anguish or fruitless work for many ; and at the same time the process of finding alternative sources of supply and placing direct orders on them would have progressed as rapidly.

The moral of the story :- Say no more than required.

A BILL FOR TEA THAT WAS ONLY YEARS LATE

JUNE 1976 -four months after I had reported on Central Railway and had been posted as Sr. DEE, Kalyan Loco Shed.

One fine morning, there was a brown envelope on the table waiting to be opened by me. The Head Clerk had put up other papers as usual but this one had been left unopened.

The envelope was from CLW, from where I had come on transfer to Central Railway. I fondly hoped that it might contain some good news - some copy of advice to Central Railway to pay me arrears due to me from my assignment in CLW - Travelling allowances, for example.

I was in for a surprise, when the contents were seen. It was a letter from Dy. Chief Personnel Officer CLW, written in his capacity as the head of CLW Staff Canteen Management, requesting that I should remit some Rs.200 plus towards tea and snacks taken by me from the Canteen over the period 1968 to 1975. There were no details, nor any explanation as to why they had thought of collecting this amount from me so late.

I used to order tea and snacks occasionally for my personal consumption and more often for meetings with visitors etc., when I was functioning as Dy.CEE in CLW. The money used to be paid to my Head Clerk then and there and I had thought no more about it. It was possible that I may have missed paying him sometimes, but I did not believe that the dues would have swollen to such a tidy sum.

I wrote back to the Dy. CPO/CLW that I had paid for all the tea I had consumed over the seven years of my stay in Chittaranjan and that I had in any case no intention to comply with his demand. I did not hear further from CLW. I suppose the amount must have been "written off" under sanction of the "competent authority"!

Talking of tea consumed while at Chittranjan reminds me of a funny episode of 1974. It was one of those regular monthly meetings that I, as Dy.CEE in charge of Traction Motor Development used to hold with officers of the Stores Deptt. to review availability of

important long-lead and imported materials required for production. We had tea and biscuits as usual. The meeting over, everyone had left barring my SEE. The peon entered and handed over to me some loose change (a few rupees) and I pocketed it. My SEE who was watching the proceedings came out with this remark, hesitatingly and showing as much politeness and courtesy as he could possibly muster. "Sir, I thought I had given the Rs.20 note for tea".

I had been known for my absent mindedness in matters other than purely official. My mistake was forgiven. The loose change changed pockets, with smiles on both sides.

WHEN DROPS DROWNED ME, A DELUGE CAME TO MY RESCUE

A day in the first week of June 1976. It was one of the most depressing days I had ever gone through, in my career. Yet, only a day earlier, I had been fully relaxed and happy, totally oblivious to the grim realities that were waiting for me, round the corner. I was on a visit the earlier day to the Electric Locomotive Workshops - Bhusawal accompanying CEE/C.Rly, at his bidding. I was Sr.DEE, Kalyan Loco Shed then. I had little to contribute at the time of CEE's inspection of the workshops. However I enjoyed the hospitality of the officers of the workshop and the Bhusawal Division in CEE's company.

The pleasure changed to pain next morning. We were in CEE's Inspection Carriage on our way back to Bombay. The train was about four hours behind schedule at Igatpuri. We were told that there had been incessant rains in Bombay area and due to flooding of tracks at some places on the suburban section, the EMU train services had been affected ; of greater concern to me was the information that a number of DC locos had become defective and had to be withdrawn from service, thereby reducing availability of locos for train services. Our train managed to reach VT. around noon time and I was at my residence at Badhwar park, Colaba by 1 p.m. There had been a spate of telephone calls, my wife said. I finished my lunch hurriedly and travelled all the way back to Kalyan reaching the Loco Shed by 4 p.m.

The situation was indeed grim. Against a targeted availability of 30 Locos for goods traffic, only 20 were in service, a large number of locos having had to be withdrawn for

various defects, the most important being damage to equipment from leakage of rain water from the Locomotive roof. Both the new WCG-2 type and the old WCM type locomotives featured in the affected list. The officers and supervisors were straining hard to complete repairs and attention. The leaking locos were being tackled by applying a 'Shalimar' sealing compound at suspected locations on the roof. I knew this would only be a temporary remedy. But they assured me that this was the standard "Monsoon Treatment" adopted for many years; but as the first showers had occurred a few days earlier than usual, we had got into the mess. I inspected a couple of locos. The extent of leakage was not very heavy but the few drops that did get inside could indeed do sufficient damage to the electrical insulation at vulnerable equipments, leading to earth fault. The water found its way mainly at the 'hatches' made in the roof for lowering and taking out equipments. The gaps in the roof at the mating surfaces between the roof structure and the panels for these 'hatches' was the main problem area. I agreed that the immediate concern should be to do whatever restoration or repair could be done quickly to make the locomotives fit, one by one. I let the work go on and when I left the shed by 8 p.m., the availability of goods which had dropped in the evening to 15/16 locos was coming up to 20 - far below target still. My officers assured me that they would continue to tackle the crisis on a war-footing, staying in the shed throughout the night if necessary. What a dedicated and devoted team that was. The rain had stopped in the evening and the prospects of further arising of defective locos on leakage account would diminish, I consoled myself.

When I entered my house at Colaba, it was about 10 p.m. There was a phone call from Sr.DOS. Soon followed calls from Dy.DS and Additional COPS. If the position did not improve, they said, even running of passenger trains might be affected. I explained to them briefly the nature of the problem and how the shed was working hard to meet the challenge.

But I decided then and there that I should not be at home any longer ; it would not only affect my peace of mind but phone calls would disturb my family. After a hurried dinner, I took a taxi to reach VT. I was in the Control Rroom by 11 p.m.

In such situations, the Control Room is a much better place to be in, I discovered. I could keep in touch with the loco availability position - Loco by loco and minute to minute without asking questions of anybody. The position was improving and by midnight goods availability had reached 24/25 locos, which was not too bad in the circumstances.

It was then that I noticed that a sudden gloom had descended in the atmosphere. There was bad news. The North-East section between Kasara and Igatpuri had been flooded, the tracks had been badly affected at many places as no trains could ply on the Ghat section. The flooding had probably taken place due to some carelessness in the construction work that was in progress at that time for a new Third line between Kasara and Igatpuri. That was the report from site.

The 'Thirst' for locos and pressure on the shed eased instantly. I heaved a sigh of relief. This could give me some more time to recover, some more time to push locos from Shed. It must have been around 1 a.m. I saw COPS, Chief Engineer (Open Line) and Chief Engineer (Construction) standing in front of me in the control room. COPS did not ask me a word about availability of the locos. He wanted a loco with crew to be arranged immediately for them to go to the NE Ghats. I looked at the Loco Power Controller. There was a locomotive at the VT. platform. The Driver and Assistant Driver were also there - some passenger train had been kept behind at VT. itself because of the reported floods in the Ghat section. The COPS thanked me and left with the others for the platform.

The report from the shed was one of further improvement. I told the officers to go home. They had indeed strained themselves. I went home too for rest, after a hectic day. Indeed, a deluge had come to my rescue when drops had drowned me.

That is not end of the story. The nightmarish experience had taught me a lesson. No more of relying only on 'Shalimar' compound, I said to myself. The next week was devoted to examining roofs of quite a few locomotives in the shed. Even within the WCM group itself, we had 5 different types of locos, each having some peculiarity in the construction. Bhasin, my AEE was of great assistance. We would stand on the roofs and discuss alternative solutions

to improve the structures, the drainage, the gasketing, the method of securing the `hatch' panels etc., the objectives being to realise a water-tight roof with minimum alterations. We could evolve satisfactory solutions. I decided that the WCM locos -49 in all - would be tackled in the Shed itself using our own resources of men and materials and that the 57 WCG-2 locos should be got done through a contractor in the shed, to clear designs and drawings evolved by us. In this effort of arriving at a satisfactory improvement, information was shared with BSL Shop, CLW and RDSO. (The RDSO have since recognised the importance of design from the aspect of roof leakage and in conjunction with CLW have been working out and implementing fundamental improvements to eliminate the problems on future builds of locos).

When I left the Bombay Divn. a year later on transfer to Headquarters, about 75 % of the fleet had been tackled. Bhasin had made a significant contribution in this work. In the monsoon of 1977, much fewer locomotives showed sign of distress. By and large, the problem had been licked, without having to consume tonnes of the `Shalimar' compound.

I believe that the entry of water into the locomotives can totally be prevented , only through a carefully thought out design in the structure and openings, and through meticulous attention to workmanship in manufacture. On the old locomotives, improvements such as were attempted in 1976-77 may continue to be called for time to time to take care of distortions and damages arising in service due to frequent handling of the `hatch' covers. Even so, I have little doubt that the magnitude of the problem can never be so severe as was experienced in 1976; and that the change in philosophy and approach introduced in that year continues to guide action at the field level for overcoming problems as and when they arise in the Shed.

THE INTRODUCTION OF DYNAMIC BRAKING ON WCG-2 LOCOS

Early in 1976, due to personal reasons, I wanted a posting in Bombay. Having done eight years in remote Chittaranjan, I thought a place with educational facilities for my

children would be good for me. CEE/ C.Rly helped me and posted me as Sr.DEE/Kalyan Loco Shed, as he thought that I could be of maximum assistance to him on this assignment.

And Kalyan was in Bombay Division. It was only later that I came to realise that I would be working under a D.S., who was one year junior to me in service and that my confidential report would be initiated by a Dy.D.S. who was 3 years my junior. But this knowledge was kept aside and although there were minor pinpricks, I carried on and gave of my best to the Railways, as ever before.

The beginning of my career on the Bombay Divn. was funny. I entered the DS's room only to find a meeting going on. I thought that the person chairing the meeting was the DS and greeted him. There was some hush-hush among the officers present. The chair person talked to me in a tone that I thought was too autocratic for a DS who had known me only for a couple of minutes.

" Your first job is Dynamic Braking on WCG-2 locos. I want to see some progress" he said.

I left the room, excusing myself. It was only later that I came to know that the person in the chair was Mr. Krishan Chandra, the CPLO who was looking after GM's work and that the DS was one amongst those seated in front.

At Kalyan, I could not locate a single clear order either from the Board or from the CEE on any file, directing the shed to do the work of Dynamic Braking on WCG-2 locos. All that I was shown was a single line Inspection Note of MM to the effect that Dynamic Braking was to be provided on these locos. There was also no decision recorded anywhere on the technical details of this work.

At that stage, over 40 WCG-2 locos had been received by Kalyan Loco Shed from CLW. All these locos had been turned out by CLW without the facility of Dynamic Braking although

it was catered for in the design. More locos were being received in the same condition. The excuse apparently was that CLW had not received the necessary equipments for fitment.

The shed officers and operating officers whom I consulted were unanimous that Dynamic Braking was desirable and necessary, if only to minimise the incidence of goods trains entering catch sidings on Ghat Sections, leading to disasters. Indeed, one locomotive had been done on Central Railway under the guidance of the CEE/Construction who had taken some initiative. I learned later that such initiative was perhaps not very much to the liking of the CEE/Open Line, who was really the boss.

A few days in the division convinced me that Dynamic Braking was a good thing to do for safety in Railway operation, I was also convinced that we should not wait for any equipment but go ahead with a system of Rheostatic Braking, using the Starting Resistors as Braking resistors in the Braking mode. But I was clear that an order or directive from the CEE/Open Line was absolutely necessary before the Shed took up this major work. The problem was solved very simply. I made out a Technical paper outlining two alternative schemes by which Dynamic Braking could be provided and sent it to the CEE, seeking his orders as to which scheme I should follow for implementation. I referred to MM's Inspection notes and GM's oral instructions. I also conveyed that I was myself convinced that Dynamic Braking would improve safety of goods train operation of the Ghat sections. My strategy was somewhat like that of the clever shop keeper who shows you two sari's and asks you which one you would choose for your wife.

Back came CEE's orders in a week approving of one of my schemes.

A Senior Electrical Engineer of the Construction Organisation had been stationed in the loco shed for some time to keep a watch on the performance of the WCG-2 locos - a peculiar organisational method which was further confounded by a clash of personalities between CEE/Construction & CEE/Open Line. This Engineer was intelligent and keen. I asked him to take up the work. He had a clear concept of what was to be done and how. Support by way of staff and facilities from the shed was given to him, with the cooperation and consent

of other officers directly in line in the organisation of the shed. The Cell thus formed was made answerable to me and not to CEE/Construction and was asked to progress the work. I also directed that proper drawings should be made as the work progressed on the prototype and our attempt should be to standardise on the details of the job so that execution on a series of locos would be made easy. It was my good luck that the CEE/Construction did not object to my taking the initiative and control. He was perhaps happy that the CEE/Open Line had been forced to reconcile himself to progressing a work on the basis of a technical idea that initially had come from the CEE/Construction.

I gave advice and decisions as the work proceeded. But very little was needed really to push things, as the atmosphere in the shed had become one of cordiality and cooperation instead of confrontation between the SEE/Construction and the other officers of the shed. In less than 3 months, the job on the first loco was completed using mostly the material resources of the shed. It was a success. In a year's time, about 18 locos were completed, preference being given to those employed on Banking duty on the Ghat Section.

The job was done on more locos progressively, after I left shed. It has been completed on the entire fleet, to the same design and scheme in principle.

Dynamic Braking includes two aspects - Rheostatic Braking and Regenerative Braking. The former uses Resistors to absorb the power from the Traction Motors working as generators, thereby producing a Braking effort. The energy is wasted by dissipation in the Resistors. Re-generative Braking employs a return of the energy from the generators to OHE, instead of its being wasted. The original design as conceived of by RDSO catered for both these aspects to be provided on the WCG-2 locos. However as the extra equipments required for Regenerative Braking had not been received by CLW (infact even the design of the equipment had not been settled between RDSO, CLW and the supplier, namely BHEL), the locomotives were sent without provision of any Dynamic Braking facilities. What was done by Kalyan Loco Shed was to provide only the Rheostatic Braking facility, which did not require any additional equipment.

It is not known whether the design of the special equipment was ever settled. A further question mark is whether the OHE and Substation systems are capable of receiving re-generated power and energy from the locomotives going down the Ghats , in a reliable and regular manner, even today.

My technical contribution in this Project of providing Dynamic Braking on WCG-2 locos was pretty little. Most of the work was done by the SEE/Construction and the Shed officers. But I am inclined to believe that in deciding on a workable scheme, in precipitating a clear approval from the CEE and in creating a congenial atmosphere in the Shed for the work to be done smoothly, I had made a significant management effort, which led to success ultimately. It is a fact that the provision of Dynamic Braking on WCG-2 locos even to the limited extent of only a Rheostatic Braking facility as done then played a vital role towards improved operation and safety on the Bombay Division in subsequent years.

HOW BRAINSTORMING HELPED EVOLVE RE-DESIGN OF A CARBON BRUSH

One of the many technical problems that I faced on the reliability front, as soon as I took charge of the post of Sr.DEE, Kalyan Loco Shed in 1976 was a spate of failures of the carbon brushes used on the BHEL Traction Motors of WCG-2 locos. The brushes used to break in service and the broken portions along with the pigtail used to touch the motor frame resulting in "earth fault", tripping and failure of the locos. Occasionally, there was damage to the Brush holders and Commutator, due to the flash-over which accompanied the breakage. This problem affected locomotive reliability and availability adversely, quite significantly.

A look at the RDSO drawing to which the brushes were being procured and an examination of the broken brushes was enough to convince me that the design was not satisfactory and needed to be changed. The brush had a cut to certain depth to accommodate a rubber top and it was at the corners of the cut that the failure originated. It was clear that while a rubber top may be beneficial, a cut to accommodate it was certainly harmful and should not be allowed. I had a good idea about the kind of change that was required ; but, I did not choose to impose at once a new design based on my thinking.

Instead, I decided to resort to Brainstorming as a technique for finding a solution. My reasoning proceeded on the following lines :-

- A reference to RDSO was to be ruled out as that could result in some kind of defensive mechanism from RDSO and consequent delays.
- There could be equally satisfactory or even better solutions than what had struck me at a first look at the problem.
- I had to establish convincingly to RDSO and others that it was the design that was basically at fault - not operation nor maintenance.
- The shed had lived with this problem for more than a year and a few months' delay in implementation of a good solution could be tolerated in the long-term interests of cent percent reliable performance in the future.
- There were many other technical problems on the locomotives and I felt that I should gain and build up the confidence of the officers and supervisors in me - a new entrant to the Central Railway Traction cadre - and in themselves, for finding successful solutions on a sound basis instead of through hit-and-trial methods.

At the Brainstorming session, about 20 persons comprising engineers and supervisors from the DC loco and EMU sheds, operating personnel and representatives of manufacturers and suppliers of carbon brushes to Kalyan Loco Shed participated. The problem was explained ; the failed brushes were seen ; and the drawing examined. The participants were asked to speak out their analysis and to suggest possible solutions.

At the end of the session which lasted about two hours, it was decided by common consent that:

- (1) Out of some 8 alternative solutions that were thrown up, we need not consider three seriously for further evaluation.
- (2) Monitored trials on a few locos should be done for a limited period of six months with brushes manufactured to five designs on some motors, the RDSO design being continued on these trial locos as 'reference samples' on the other motors.
- (3) On motors on all other locos, RDSO design brushes would continue as per practice.
- (4) Results of trials could be the basis of decision-making for determining the most satisfactory solution.

The session also helped determine the design of the trial scheme in sufficient detail so as to ensure that extraneous factors would not influence the results. The parameters to be watched such as the physical condition of the brush, the condition of the commutator, wear rate of brush, incidence or otherwise of failures, etc. were decided at the meeting.

It took a month or two for supplies of brushes as per new designs to materialise and another four to six months for the trials to be completed. Even as trials were in progress, the failures on brushes to RDSO design continued; and there was clear evidence that all other designs fared better and the shed officers strongly felt at one stage that the RDSO design must be given up immediately. However, the trials went through to completion as planned, for a proper evaluation. Two designs came out as favourites for being considered as a longterm solution. One of these was adopted and the problem of breakage vanished completely.

The above experience helped me later when I functioned as Director (Standards) Electrical, RDSO to review all the drawings issued by RDSO and by Railways for various types of carbon brushes for Traction application and to issue a fresh set of comprehensive standard drawings for adoption on all Railways.