New Chemical Recovery Boiler

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Central Pulp Mills Ltd. (CPM) was taken over by JK Group in 1992 and has made steady progress. JK - CPM gradually improved its pulping capacity from 38,000 TPA to 44,000 TPA with addition of one digester and installing BSW IV. For handling equivalent BL solids JK - CPM had a renovated and upgraded Recovery Boiler of 250 TPD BLS firing capacity. With some minor modifications / improvements in Pulp Mill JK - CPM felt that pulp production can further be increased to 48,000 TPA but Recovery Boiler was one of the major constraint. Also after pulp mill modernisation by installing ODL plant, pulp production will touch a figure of 50,000 TPA. Hence a need of a new Chemical Recovery Boiler was urgently felt to avail the benefits of higher pulp production. Order was placed on Enmas Andritz Pvt Ltd (EAPL), Chennai for supply of a 335 TPD BLS firing capacity Recovry Boiler of single drum (outside of gas path) design with membrane wall of furnace, decantation type hearth, panel type boiler bank and economiser. A state of art of technology Recovery Boiler was designed, supplied, erected and commissioned in a record time of 14 months and 28 days. This was achieved due to one team working and not distinguishing as customer - supplier relationship. All activities were carried out in coordinated way rather than conventionally, thus achieving Boiler commissioning in record time of 14 months and 28 days. In addition to record time, boiler was stabilized in first start up with 80% MCR firing within 72 hours and continued to run for 3 months. A pillar "Early Management" of Total Productive Maintenance (Japanese Concept) played remarkable role in this challenging achievement. Various abnormalities / deficiencies and improvements in technology were taken care in TPM methodology. Total 78 fuguais (abnormalities / deficiencies / improvements) were focused during design, manufacture, installation and test run stages. Major advantages achieved are increase in reduction efficiency, steam generation, boiler runnability and decrease in boiler cleaning time.

INTRODUCTION

JK Paper Ltd. Unit CPM Fort Songadh. Gujarat has a Chemical Recovery Boiler supplied by Babcock & Wilcox, USA commissioned in 1968. This boiler was designed for firing capacity of 207 TPD BLDS. However this boiler could be operated maximum @ 170 - 100 TPD DL Solids firing due to various constraints up to 1986 and thereafter remained shut during 1986 - 1993. Subsequent to take over of the mill by JK Group in the year 1992 the boiler was renovated & upgraded for rated capacity of 225 TPD BLDS by Enmas Andritz Pvt Ltd (EAPL), Chennai earlier known as Enmas Process Technologies Pvt Ltd. Madras. In August 2000, this boiler was further upgraded from 225 TPD to 250 TPD BL Solids firing capacity by Enmas Andritz Pvt, Ltd. Chennai to meet the enhanced requirement of pulping from 42,000 TPA to 44,000 TPA bleached pulp and this boiler was being operated at 250 - 255 TPD BL Solids firing capacity. JK - CPM envisaged that there was still margin in pulp mill to increase pulp production to 48,000 TPA, further renovation and upgradation of Recovery Boiler was not possible due to hearth area constraint. JK CPM also planned to go for Pulp Mill modernisation by installing Oxygen Delignification plant to meet CREP requirement of 1.5 Kg/T AOX level. This will also help in increasing pulp production to 50,000 TPA as major constraint of bleach plant will be overcome by reducing Kappa No before bleaching by ODL. Hence there was need to handle 1,00,000 TPA BL Solids, which was not possible with Babcock & Wilcox Recovery Boiler.

JK - CPM therefore decided to install a modern New Chemical Recovery Boiler of 335 TPD BLS firing capacity to take care of the increase in pulping capacity. JK - CPM awarded the contract for engineering supply, erection and commissioning of the New Recovery Boiler with

DCS & two ESPS to Enmas Andritz Pvt. Ltd. Chemical CAPL has selected and incorporated in the boiler state _of-art technologies suiting to CPM's specific requirements.

JK - CPM after long deliberation and brain storming understood that effective project management and commissioning of chemical Recovery Boiler in the shortest possible time is the essence of the fastest realization of pay- back. Funds for disbursement were properly and strategically well-planned, proper cash inflow and cash outflow are essence of such strategic project management schedule to be made. This point was well recognised and proper cash flow arrangements were planned well prior to placement of the order.

JK - CPM had analysed the issue and options that fastest commissioning was carried out by ITC- BPL for their 625 TPD Solids firing Chemical Recovery Boiler in 15 months 4 days which itself was an uphill task and ITC - BPL deserves compliments for the same. Hence, JK - CPM also wanted not only to achieve better time record but also provide complete concrete floor at all elevations.

Ordering and Planning

JK - CPM ordered on EAPL New Chemical Recovery Boiler and issued letter of Indent (LOI) with project zero date on the 21st July 2003, projecting 18 (eighteen) months supply, erection & commissioning schedule. Subsequently formal contract was awarded on 23rd August 2003 with the commissioning within 17 (seventeen) months. Stringent liquidated damages clause (as a normal practice) and also bonus clause was added as motivation. Joint partnering and customer supplier working arrangement right from the top management to the bottom management was agreed upon to operate the contract as business partners and not as customer - supplier relationship against all conventional working methods. It was also mutually agreed upon that top head of both the organisation would chair most of the project review meetings. Project review meetings were chaired periodically by the whole time Director, Chief Executive and Chief General Managers from company side and by the MD, Director-Technical, Director operations and the Project Manager from EAPL side. The above said personnel for the project review meetings established 70% of the attendance.

Another specific strategy fixed was that when an issue was to be addressed. depending upon the nature of the issue it was mutually decided that both organizations working towards this project shall break the protocols and reach a decision making point for the success of this project. This was strictly practiced from start to commissioning in this project.

EAPL had fixed internal contract of 14 months commissioning with one-month contingency to avail rull bonus.

Execution

Having decided to have our recovery boiler in record time with complete concrete floors at all elevation, it was a challenging task to schedule and plan the activities for erection sequence. An achieved milestone is enclosed as Annexure - I. It was deliberated and agreed upon that full civil work and mechanical erection shall proceed in close coordination of joint erection sequence. Accordingly, mechanical erection site office was opened by EAPL within two months from the date of contract. Following steps were taken to achieve challenging target.

1. It was established that dispatches shall be sequential to a certain effect like conventional erection but dispatches of all components as and when ready in manufacturing shop would reach site irrespective of erection schedule.

2. To speed up movement JK - CPM awarded boiler material transportation contract to EAPL for effective co-ordination for dispatch in time.

3. Auxiliary equipments of JK - CPM scope were made available timely even planning was done for alternate arrangement available in the mill in case of delay in supply.

4. CPM helped in procurement of certain critical items available in nearby areas.

5. Area was allocated for storage yard near the site with proper arrangement to keep material safe.

6. All receipt vouchers were cleared witnin very reasonable time to release payment and avoid any financial starvation at supplier end

7. Full preparation was made to deal with rainy season and also planned to provide top roof before rain commonces.

8. Core group of cross-functional members was formed to review progress on daily basis (Planned Vs Actual) along with EAPL engineers. Instantaneous decisions were taken for removing bottleneck and constraints.

9. During execution, micro activities schedule were prepared in backward manner i. e. from end date to start date.

10. Rigorous follow up was done with various suppliers.

Role of Total Productive Maintenance (TPM), Pillar: Early Management

TPM (Japanese Concept) is under implementation in CPM. "Early Management" a pillar of TPM played a

remarkable role to remove the deficiencies experienced in Old Recovery Boiler and also to incorporate various improvements in technology and ultimately to achieve challenging target. Various abnormalitles / deficiencies and possible improvements were taken care during design stage, manufacture, installation and trail runs. All plus and minus points were considered before and during execution of the project resulting in no repeatation of work. The graph enclosed as Annexure-II indicates no. of abnormalities / deficiencies removed and improvements made and BL solids firing achieved. The details are given below.

Abnormalities / Deficiencies and improvements taken care during design stage for New Recovery Boiler.

1. Furnace wall design changed from fins type to membrane type to make it leak proof.
2. Frequent jamming of boiler bank and Economiser area taken care by following design changes:
   - Boiler design changed from bi drum to single drum, placed out of gas path.
   - Boiler bank design changed from tubular to panel type with axial flow of flue gas.
   - Economiser design changed from tubular type to panel type with axial flow of flue gas.
3. Jamming of spouts taken care by changing spouts location from front side to rear side of furnace so that hard lumps do not fall on spout area.
4. Corrosion of flue gas duct is taken care by changing metallurgy of duct from mild steel to corten steel.
5. Cascade evaporator inlet dampers jamming problem and through leakage problems are taken care by changing lovour type dampers to guillotine type dampers.
6. Expansion joints in flue gas ducts are changed from metallic to non-metallic to avoid corrosion and leakage of expansions joints.
7. Pumps gland packing is changed with mechanical seals to avoid damage or leakage of gland packing of pumps.
8. BL lines erosion problem is taken care by changing pipelines from mild steel to stainless steel.
9. Coupling of fans design is changed from pin bush coupling to bibi coupling.
10. Fans bearing design changed with metallic seals to avoid failure of bearing.
11. Main dissolver tank (MDT) is provided with two agitators to avoid jamming of MDT.
12. Scrubbing system provided in MDT vent to reduce chemical loss and jamming of Vent.

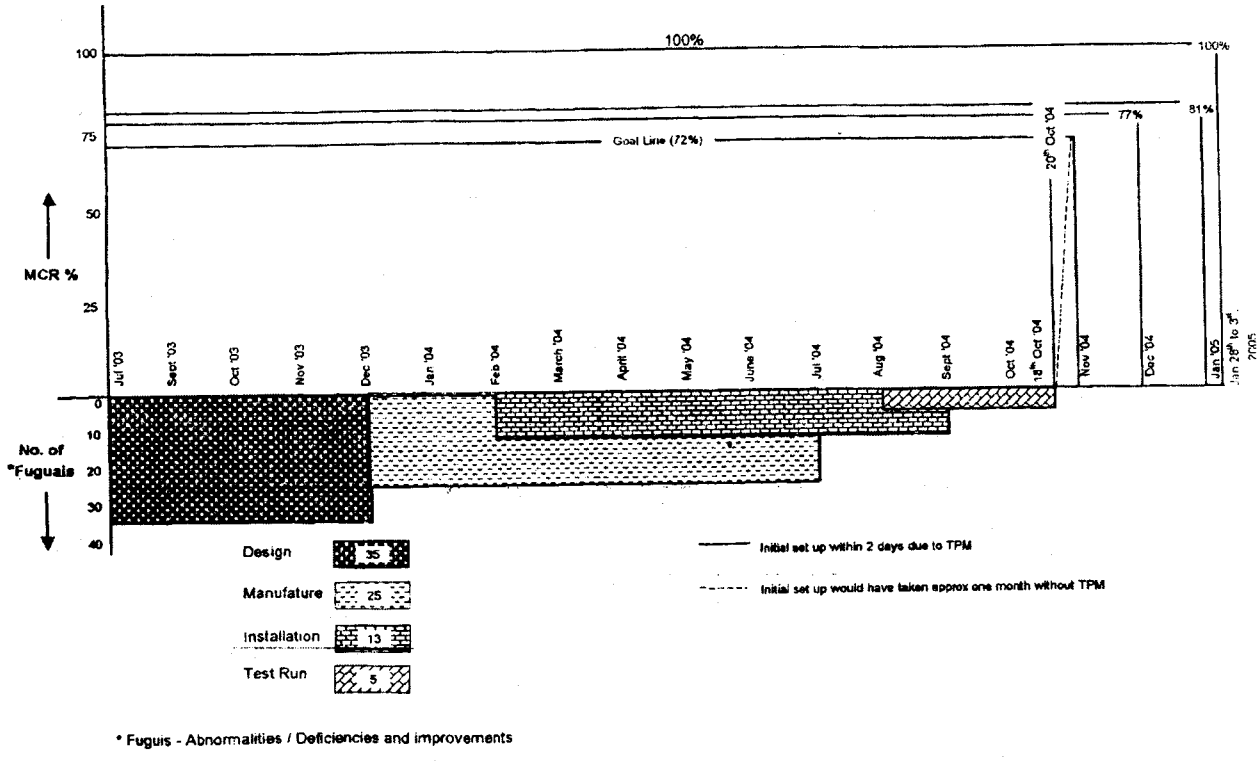

Fig.1 : Total Productive Maintenance Pillar - Early Management

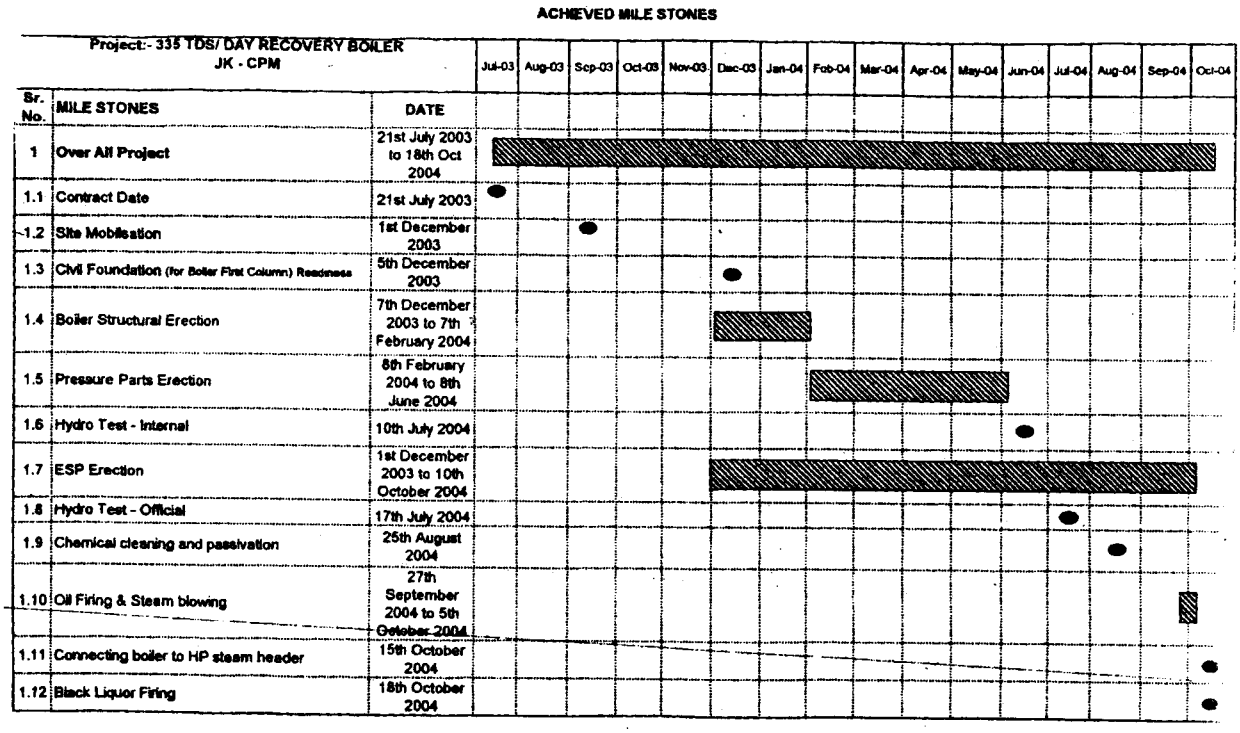

Fig. 2 : Achieved Mile Stones

13. Oil burner design is changed for better oil combustion.
14. Burner management system is provided for efficient use of fuel oil and proper safety.
15. All valves of size 8" and above diameter are provided with gear for easy operation.
16. Salt cake and boiler bank ash mixing tanks metallurgy changed from MS to SS.
17. High-speed agitation system provided in SCMT & BB ash mixing tank to avoid jamming of mixing tanks.
18. Motor operated valves are provided for main boiler operation (4 nos.).
19. Rappor control panel provided for effective rapping of ESP rapping mechanism.
20. One crusher is provided to crush boiler bank ash to avoid gun chocking.
21. VFD is provided to salt cake feed screw for fine control of salt cake feed.
22. Standby ID fan is provided to improve runnability of boiler.
23. Mass flow meter is provided in firing liquor line for better control of firing rate.
24. Provision is kept to install to bigger economiser with minimum shut period in future when cascade evaporator will be removed.
25. Online O_2 and CO_2 measurement provided for better combustion control.
26. Complete DCS system is provided for efficient operation of boiler.
27. Provision for lift is provided for easy movement for material and manpower.
28. Liquor level control system is provided in flow box and mixing tank to make operation friendly.
29. Oil flow meter is provided for better control of fuel oil.
30. Two separate staircases are provided from ground floor to top floor for safety and easy access to boiler area.
31. All MCC & VFD are installed in dust proof & room to avoid rustling of penals and is avoid failure of electrical equipments due to heat.
32. All cable trays kept vertical instead of horizontal to avoid accumulation of foreign material on cable trays.
33. An extra feature of timer is provided in all soot blowers to retract soot blower if reverse limit & switch fails to operate.
34. Pressure gauges are installed at centralized location

to check steam pressure of individual soot blower after puppette valve to monitor effective operation of soot blower.

35. Indoors dry type natural air-cooled transformers provided to reduce maintenance cost, improve safety and Improve efficiency.

Fuguais taken care during manufacturing

Additional relays incorporated for DCS system	12
Rang of CT altered	5
Provision for 3 nos. of additional pumps made	3
Extral connectors for bus joining of VCBs incorporated	3
The location of neutral connector of transformer got shifted from safety point of view.	2
TOTAL	**25**

Fuguais taken care during Installation

Cable route changed for ESPs to reduce length of cable	1
Independent earth pit provided for VFDs	1
Control circuits modified in ESP's field no. 1, 2, and 3 to stop high-tension during rapping.	1
Boiler Bank crusher speed decreased to reduce vibration.	1
Speed of smelt dissolving reduced to reduce load.	1
Total	**5**

Fuguais care during Trial run

CT ration of approximately 12 nos. checked and short circuit removed	12

Design Features	**Unit**	**Parameter**
Blac liquor firing capacity	TDS/day	335
Steam Generation	T/Hr	35.42
Superheater out let Temperature	°C	405± 5
Superheater out let Pressure	Bar	44
Excess Air	%	16.7
O_2 in flue gas	%	3.0
Humidity - Dry air	g/Kg	21
Boiler Features		
Health area	M^2	17.30
Height up to nose	M^2	15.23
Drum Centre elevation	M^2	32.30
Heat transfer area		
Furnace	M^2	451.00
Boiler Bank	M^2	1071.00
Economiser	M^2	584.00
Superheater	M^2	617.00
Furnace screen	M^2	234.00
Rear wall exit screen	M^2	29.30
Gas Temperatures		
Super heater inlet	°C	740.00
Boiler bank inlet	°C	570.00
Economiser inlet	°C	410.00
Cascade inlet	°C	340.00
ESP inlet	°C	170.00

Additional earth pit provided for ESP to improve earth value. 1

Total 13

Conmmissioning

Normally, under commissioning, pre-commissioning test and commissioning activities are scheduled after completion of the mechanical erection and hydro testing. In this case as and when the mechanical erection of equipments were complete, pre-commissioning checks of the equipments were carried out and all equipments were kept ready for direct commissioning. Boiler was commissioned in a record period of 14 months and 28 days schedule. The boiler was stabilized on 80% load within 72 hours of commissioning and has since operated continuously for 3 months without any trouble.

Salient Features of the New Chemical Recovery Boiler

JK - CPM had placed an order on EAPL for the state of art recovery boiler knowing fully that the presence of silica in the raw material at very high levels will be a major cause of concern. Hence in the modern era. the boiler was so chosen with direct contact evaporator (Cascade Evaporator) though the project was conceived to construct and install large vertical economizer on a later date. This economiser can be erected without major down time of the boiler as and when JK-CPM address methodology of overcoming the silica problem in the raw material. Subsequently boiler was designed so as to erect the economizer in complete and hook up with the existing first pass arrangement with very minimum down time.

Among various salient aspects of the boiler are as follow.

Boiler Pressure Part System

- The boiler has both radiant and convection heating surfaces arranged suitably in order to cool the combustion gases and facilitate effective cleaning of the heating surfaces and also for natural circulation of boiler feed water.
- The boiler is a single drum design unit. The boiler bank has convection heating surfaces consisting of vertical tube platens.
- The membrane type water walls of the boiler furnace are all welded construction with seamless tubes and carbon steel fins between, forming a gas tight construction
- The furnace has a decanting floor. The combustion air is supplied to the boiler through conventional three level system with independent air fans and airports appropriately positioned at different levels designed for effective black liquor burning.
- Standard platen type pendent superheaters are provided. The superheaters are arranged in two stages with one spray type desuperheater in between the stages for steam temperature control.
- Long retractable soot blowers clean the superheaters, boiler bank, and economiser- heating surface. The soot blowers are operated through a remote /auto sequence from separate soot blowing panel.

Water and Steam system

- In this single drum design there are two separate water / steam circuits designed with large individual external down comers to ensures an adequate and positive water flow to the lower furnace wall headers and the generating section.
- The feed water enters the bottom common header of the economiser. It then flows through individual panel inlet headers upwards in the individual economiser panels, in counter flow to the flue gas, to the top panel headers and then to the common outlet header.
- The feed water flows from the economiser common outlet header to the boiler drum through a DOLEZAL sweet water condenser. This condenser is provided to condense a part of the saturated steam from drum which in turn is used in the Desuperheater for the SH. The boiler drum is provided with full complement of valves and fittings including 5 elements drum level control and remote monitoring instrumentation. The drum internal fittings like cyclones and baffles are provided to separate water droplets from the saturated steam generated. The drum is provided with two safety valves vented out to atmosphere.
- The boiler water flows through two nos water wall down comers and supply pipes to the water wall bottom headers- Similarly the boiler water flows through a set of down comers to the boiler bank inlet common header and screen inlet common header. Independent supply connections are provided for extended sidewalls to insure adequate circulation.
- By the process of natural circulation induced by density difference the water and steam mixture rises in the water walls, screen platens and boiler bank panels to the respective outlet headers and through riser pipes to the steam drum.
- The steam drum is equipped with primary and secondary separators. which separate water from saturated steam. The primary separator (cyclones) makes the raising steam /water mixture swirl, which forces the heavier water towards the perimeter of the cyclone and out through the bottom allowing the lighter steam to raise and exit the cyclones at the top. The saturated steam, which is virtually moisture free, continues through the secondary separators (demisters)

Benefits achieved over Old Recovery Boiler

	Old Recovery Boiler	New Recovery Boiler
Reduction Efficiency (%)	82 - 84	90+
Net Steam Generation per tonne BLS fired (T)	1.9	2.2
Pulp Production per month (T)	3670	4070(Dec'04)
Boiler Runnability in months	1	3(Minimum)
Boiler Cleaning Time (Hrs)	80	48
Reduction in soot blowing frequency & Steam	Six time per day	Three time per day
consumption (T)	60	30
Reduction in Stack Emission (mg/Nm^3)	150	<100

Average BL solids fired

Month	%MCR
October '04 (18th Oct to 31th Oct.)	72
November '04	72
December '04	76.60
January '05	80.67
January 28th to January 31th	100

before leaving the drum. The demisters are tightly meshed screen bundles, which remove and capture any remaining water mist that may have passed through the cyclones.

- Rapid draining facility for the furnace in the unlikely event of a smelt water explosion is envisaged. The furnaces down comers are equipped with one rapid drain line and another one to the boiler bank. Both lines are provided with two motorised valves for remote operation from the control room.

Soot Blowing

- Seventeen and sided long retractable soot blowers are used to remove the ash deposits from the superheater, boiler bank, and economiser. Steam for this soot blowing is rapped from the main steam line.

- These soot blowers are utilized to water wash the boiler during shutdowns. The water is supplied from the mill water header and washing is done with a separate wash water pump of 50 M^3/hr capacity and 140 Meter head.

ESP

- Make BHEL
- Type FAC - 1×32F Z×32H-4570-Z(Concrete casing)
- No of Chambers Two
- No of fields in series Three in each chamber
- Pressure drop across ESP 25 mmWC
- Efficiency 99.50%

Key points for the success of the project

- Carrying out civil work in tandem with mechanical, electrical and instrumentation work.

- Exhaustive interactions at regular intervals at project site to highlight and sort out the issues, thereby taking spot decisions.

- Team support and project follow-up as a single team close team coordination with visualizing the need for oncoming activities.

- Implementation of the process requirement and operation logics based on the earlier experience.

- For expediting the civil work, M.S. beams were used for all floors and encased with concrete mixed with admixture.

- All jobs were done to the maximum possible accuracy and no repetition of any job was required.

- Role of "Early Management", a pillar of TPM (Total Productive Maintenance)

- First internal hydro test was taken on June 10th 2004, which was 100% successful.

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