# MODIFICATION OF CONSEP ASSEMBLY OF ARU 500 MW CPU NTPC FARAKKA-A CASE STUDY

The Condensate polishing unit prevents premature chemical failure and deposition within the power cycle which would have resulted in loss of unit efficiency and possible mechanical damage to key generating equipment. The 500MW NTPC FARAKKA CPU ARU was supplied with flanged bottom CONSEP assembly. .Due to failure of CONSEP assembly of ARU the resin started coming out in the drain line during regeneration. It is also learnt that this assembly has failed at more than 7 NTPC stations. Due to failure of CONSEP assembly of ARU the resin started coming out in the drain line during regeneration .In this paper author explains how this failure has happened ,what were the failure repurcations and how this entire CONSEP was redesigned and developed inhouse for the first time in NTPC and huge financial implication could be avoided in terms of spares cost and unit availability .

## BRIEF DESCRIPTION OF REGNERATION PROCESS:

The system comprises :a)Separation / anion regeneration unit b) Cation regeneration / mix and hold unit c)Interface isolation vessel as shown below:

CPU ST 3

ANION REGNERATION UNIT

The regeneration units are rubber-lined pressure vessels with a header and lateral distribution system for the reactivation chemical injection. The exhausted resins are regenerated through sequential injection of water, air, chemical etc.,

## ARU INTERNAL DESIGN:

As per drawing supplied by the OES(Original Equipment Supplier) only outer dimensions can be ascertained .Internal details are not available as being proprietary item of OEM.

The resin is supported on an epoxy-bonded sand matrix in the anion unit, into which is set a collection/distribution lateral system. This matrix retains the resin while allowing flow of air or liquid. Its open nature will also allow removal of fine particulate matter by the combined air scour/rinse down technique.

Sequence 1 – Transfer of Spent and Recharged Resins

Sequence 2 – Resin Cleaning & Classification

Sequence 3 – Resin Separation and Cation Transfer

Sequence 4 – Resin Regeneration

**PROBLEM STATEMENT**: During transfer and regeneration of exhausted CPU resin, it started coming out through the drain line and it was difficult to regenerate the resin in such condition. The loss of costly resin was also a major concern.

## CHALLENGES FACED AT SITE AFTER THE FAILURE OF CONSEP ASSEMBLY

The drawing supplied by OEM could only give details of outer dimensions of vessel without having any internal details (being proprietary item of OEM). Only part no. was provided with the drawing. Internal configuration of this vessel cannot be assessed without opening the vessel. The design of P&I drawing of this system is so congested that lot of valves, actuators, pipelines, air and water line connections, C&I control panel are to be removed for getting access to the vessel internal. Therefore, in case of failure of any vessel internal a lot of pre-maintenance activities are to be carried out before actual assessment of the failed component.

## ACTION TAKEN :

Upper side manhole was opened to get the idea of internals of ARU unit. All associated pipeline and gauge glass, hand holes were opened, and all pipelines removed. After that vessel bottomside pipeline was dismantled. Initially It was suspected that resin is leaking from the central portion and along the side walls of separation assembly ( It is sand made porous assembly). Vessel was boxed up after repair of the assembly with adhesive and again resin was filled in the vessel, but after trial it was found that still resin is coming out from the vessel. Then it was decided to remove the flanged joint of bottom portion of CONSEP assembly**.**

## FINDINGS:

After dismantling the bottom CONSEP assembly it was observed that the central disc and its nearby sand matrix has got cracked (Fig1 &2) .It was decided to remove the entire sand material and laterals and collectors were exposed (Fig-4&5). Layerwise samples were collected as shown the figures below .It was found that bottom CONSEP assembly is casted in different size of sand grains and bonded with unknown chemicals.

FIGURE 1

FIGURE 2

FIGURE 3

FIGURE 4

FIGURE 5

FIGURE 6




## MAJOR OBSERVATIONS ON FAILURE OF SAND MATRIX OF CONSEP ASSEMBLY OF ARU:

1)It was observed that distributors and collectors at the bottom most portion were not supported with clips at the end and one end was held by the SS perforated plate.As because the coarse grains near the laterals got disturbed during air scouring and water flow during initial operation of the unit ,the cascading effect continued towards top of the CONSEP assembly developed a crack.fig -6

2)One of the major observation was that at the central portion where a SS disc was mounted over a stud ,the surrounding portion was found damaged .This has happened because of misalignment of central spindle as this was found welded joint and improper casting of sand layers around the disc.fig -5

3)The central spindle was found with welded joint which was a major cause of misalignment which should not be the case with fresh assembly .fig -5

4)The holding clamps which should have been mounted as support to lateral members were found embedded randomly scattered in sand layers which means the support was not at all robust .fig -4

5)Loosening of sand matrix due to sudden impact of air scouring ,backwash water and loosening of adhesive bonding over a period of time figure -1 .

6)The high DP across sand bed due to clogging of pores over a period of time figure 2 .

**MODIFICATION :**The purpose of ARU vessel is separation of anion and cation. During regeneration of anion resin caustic dosing is to be done .Accordingly the dimensions of SS Plate were determined and drilling of PCD holes for bolts and for mounting of strainers was carried out inhouse at NTPC Farakka Central WorkShop .Another cumbersome task was how to decide how many strainers shall be required for regeneration process.This was calculated based on the opening area of nozzles and size of laterals and collectors altogether so that flow didn't get disturbed .The location was decided along the periphery with a gap of 1.5 D and zig zag pattern was made.The central portion was kept blank so as to hydraulically transfer the resin from one vessel to other.

FIGURE 7

FIGURE 8

**RESULTS** :The SS plate was fixed with strainers and placed in between the flanges of bottom CONSEP and bolts were tightened and support was provided at the bottom portion of this plate .The entire vessel was boxed up and filled with water to carry out leakage checks .Then resin was

transferred to ARU and backwash was carried out and regeneration sequence was followed and regeneration of exhausted lot was completed successfully with all parameters in limit.

**Financial Implication of this modification:** The ARU bottom CONSEP assembly failed across seven NTPC stations amounting to aprrox.7crores in terms of material procurement and refixing contracts. Moreover the dependency over imported material over OEM shall not be there and higher costing could be avoided .Moreover the costing in terms of unit water chemistry parameters without taking CPU in service was also minimised .Loss of costly DM make up water due to blowdown and during unit startup was also minimized.

**ADVANTAGES OF THE MODIFICATION**: The modified CONSEP assembly is cheaper and repairable at site indigenously.The output between regeneration has also increased.The decurding results are better than the previous set up.

## CONCLUSION:

The inhouse design and development of bottom CONSEP assembly of ARU at site was a real challenging task which could no have been achieved without support of top management and associated departments. This effort of NTPC Farakka has given a new dimension to Make in India initiative and can also serve as a major cost saver across NTPC stations.


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