Design Details of CPU System of NTPC ACC-Based Project

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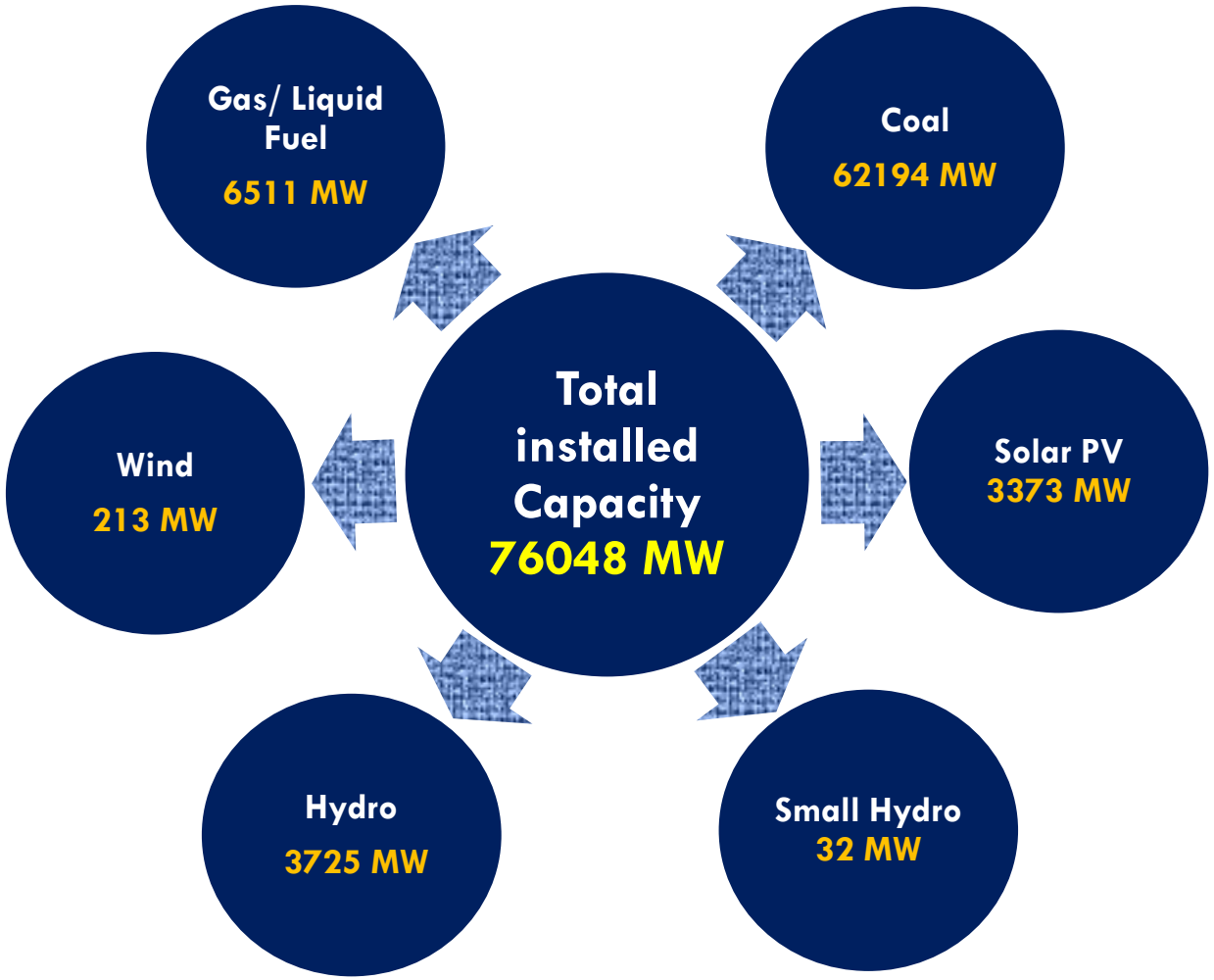
Presentation Outline

- Overview of CPU in NTPC
- Adoption of ACC in NTPC
- CPU design and issue of NTPC ACC Unit
- Major Chemistry issues observed in NTPC ACC Unit
- Cycle Chemistry parameters of NTPC ACC Unit
- Expectations from ACC Users group

NTPC & JVs : A Snapshot of Installed Capacity (22.07.2024)



Condensate Polishing Unit (CPU) in NTPC

- Deep mixed bed with external regeneration system
- CPU regeneration and operation experience for 150-1500 ppb influent ammonia
- 100% Condensate flow through CPU in SC and USC units
- Feed water chemical regime-OT in all SC & USC units and able to maintain total iron <2ppb & CC <0.10 µS/cm, in steam water cycle

Adoption of ACC in NTPC

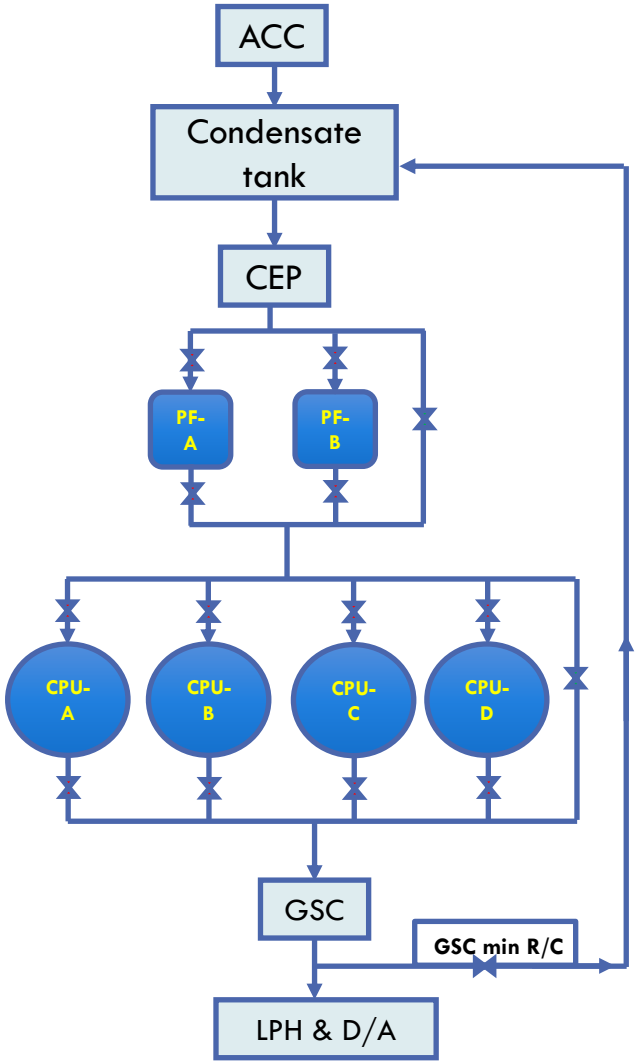
- First Air Cooled condenser in NTPC North-Karanpura (NKSTPP) project (3x660 MW).
- Patratu (3x800 MW) project is under E&C
- SC/USC-ACC units under pipeline (~13 GW)
- CPU design and operation for a very high influent ammonia is a new challenge to NTPC

NTPC- North Karanpura (NKSTPP)

- Unit capacity: 3x660MW, Supercritical, Air-cooled condenser
- COD: U#1: Mar'2023, U#2: Mar'2024 & U#3 (E&C)
- Feed water chemical regime: AVT(O), cycle pH ~9.5
- Ion exchange-based Demineralization plant
- Air-cooled condenser details:
  - ✓ Supplier: M/s Harbin Air Conditioning Co. Ltd., China
  - ✓ 10x9 streets (90 cells)

CPU Design of NKSTPP

- Deep mixed bed 4x33% (3W+1S), Spherical service vessels
- Pre-filter: 5 micron- 2x50% (2W), non-back washable type
- Two common regeneration plant (Regenerant- HCl & NaOH)
- Pre-filter design cycle: 50 hrs @ start-up
- CPU throughput: 7 days in H-Cycle
- Uniform bead size macroporous cation & anion resins



Major Chemistry Issues of NKSTPP…..Contd…..

- CPU pre-filters performance
- CPU service vessel throughput issue
- Resin separation and cross contamination issue
- High crud level leads high regeneration time and DM water consumption
- CPU resin trap frequent choking (iron particle & resin fines)

CPU DESIGN PARAMETERS OF NKSTPP (Normal Operation)

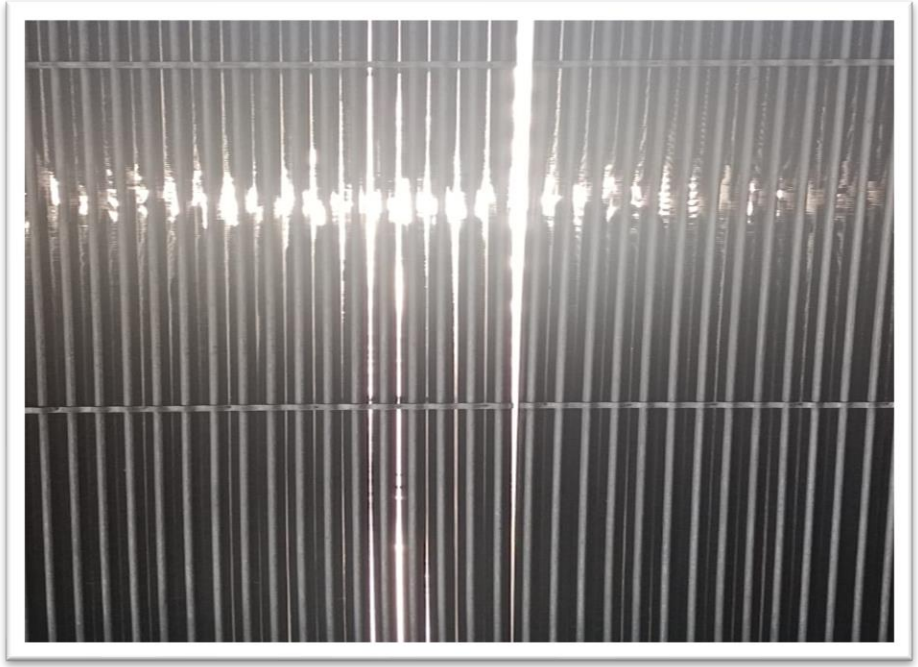
Sl. No	Major parameter	Unit	Influent	Effluent
1	Ammonia	ppb	1500	--
2	pH	--	9.5	--
3	Silica as SiO2	ppb	30	5
4	Sodium as Na	ppb	10	2
5	Chloride as Cl	ppb	10	2
6	Sp. conductivity at 25 ^{0}C	µS/cm	--	≤ 0.1
7	Cation conductivity at 25 ^{0}C	µS/cm	--	≤ 0.1
8	CRUD	ppb	50	<5

Major Chemistry Issues of NKSTPP

- Neutralization and disposal of high quantity of acidic effluents
- Resin lots are being analysed for deterioration rate
- Condensate water high dissolved oxygen issue
- Feed water high DO/Iron
- Frequent exhaustion of cation columns resin in SWAS
- Managing high condensate CRUD during startup resulted delay in achieving recommended chemistry parameter

Major ACC maintenance issues of NKSTPP

- Fan ring/wall bolt loosening & falling from running ACC fan module @ 93 rpm
- Gap between ACC tube bundles leads to cooling efficiency loss
- Fan blade bolt tightening with coupling hub by standing on bird net structure of fan module. No permanent platform.
- Fan wall supporting vertical plate was found broken in some ACC fans. Difficult for welder to go outside the fan wall .
- Fan wall are getting cut many times by running blades.
- Most of the location of ACC is not approachable for checking of air ingress/Helium test. Expansion joints (35 Numbers) in steam duct and no platforms up to 70 meter.
- Steam exhaust duct deflector plates frequently damaged



SWAS @ NKSTPP

	pH	K	CC	DCC	Silica	Na	DO
DM		✓	✓	✓	✓	✓	✓
Condensate	✓	✓	✓	✓	✓	✓	✓
CPU	✓	✓	✓		✓	✓	
D/A OL	✓						✓
FEED	✓	✓	✓		✓	✓	✓
SST			✓				
LTSH IL	✓	✓	✓		✓	✓	
MS	✓	✓	✓		✓	✓	
HRH	✓	✓	✓		✓	✓	

Any additional analyser required for ACC monitoring??

Cycle Chemistry Parameter of NKSTPP U#1 & 2

Sample	Parameter	Target/ design	Actual
Condensate water	CC (µS/cm)	<0.20	0.25-0.70
	DO (ppb)	<20	200-800
	Sodium (ppb)	<2	<2
	Total Iron (ppb)	<20	10-40
	SiO2 (ppb)	<20	<20

Sample	Parameter	Target/ design	Actual
Feed water (AVT-O)	CC (µS/cm)	<0.20	<0.20
	pH	~9.5	~9.5
	DO (ppb)	<10	10-50
	Total Iron (ppb)	<5	5-15
	Sodium (ppb)	<2	<2
	SiO2 (ppb)	<20	<20

Sample	Parameter	Target/ design	Actual
CPU service vessel	CC (µS/cm)	<0.10	<0.10
	SC (µS/cm)	<0.10	<0.50
	Sodium (ppb)	<2	<2
	SiO2 (ppb)	<10	<10
Note: CPU inlet temperature 45-65 deg C			

Sample	Parameter	Target/ design	Actual
Steam	CC (µS/cm)	<0.20	<0.20
	pH	~9.5	~9.5
	Total Iron (ppb)	<5	2-12
	Sodium (ppb)	<2	<2
	SiO_2 (ppb)	<20	<20

- CRUD analysis (100 lts) is being done on regular interval for estimation of suspended particulate in cycle water.

Expectations from ACC Users Group

- Selection of CPU scheme for feed water pH ≥9.6 (like series of Cation+MB or Cation+Anion or MB only)
- Global practices/ Operational experiences for regeneration philosophy (CONESEP/SEPREX or any other)
- How to restrict ions slippage from service-in CPU during ammonia cycle operation in SC/USC
- Maximum condensate temperature with respect to Resin
- Neutralization arrangement of CPU regeneration acidic effluent in an economic manner
- Impact of high condensate dissolved oxygen and iron on CPU resins & performance
- Feed water optimum pH (minimum value) for FAC free operation of ACC
- Impact of high pH (>9.6) on boiler tubes
- Preferred Chemical regime (AVT/OT) for ACC units with respect to minimizing iron transport/FAC

Expectations from ACC Users Group…Contd.

- Controlling measures of iron transport from air-cooled condenser
- Identification and control the air-leakages points of air-cooled condenser
- How to identify a punctured finned tube(s) in an ACC street
- Effect of ACC fan air flow/speed on condensate dissolved oxygen
- How to distinguish air ingress source (ACC/ steam duct/ Condensate tank/CEP pumps, etc.)
- Inspection guidelines for air-cooled condensers for FAC
- Whether any technology is available for real time FAC monitoring in ACC
- Preservation methodology for air-cooled condensers during unit shutdown/ any breakdown period.
- New guidelines for start-up & shutdown of air-cooled condenser-based units.

Thank You

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