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ACCs in Iran
Optimization and Challenges

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Content

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1. History of Cooling System in Iran
2. Air cooled condenser Projects
3. Optimization and Development
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History of Cooling System in Iran

Map of Cooling System In Iran

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Map of Cooling System In Iran

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Map of Cooling System In Iran

Overview of Cooling System In Iran

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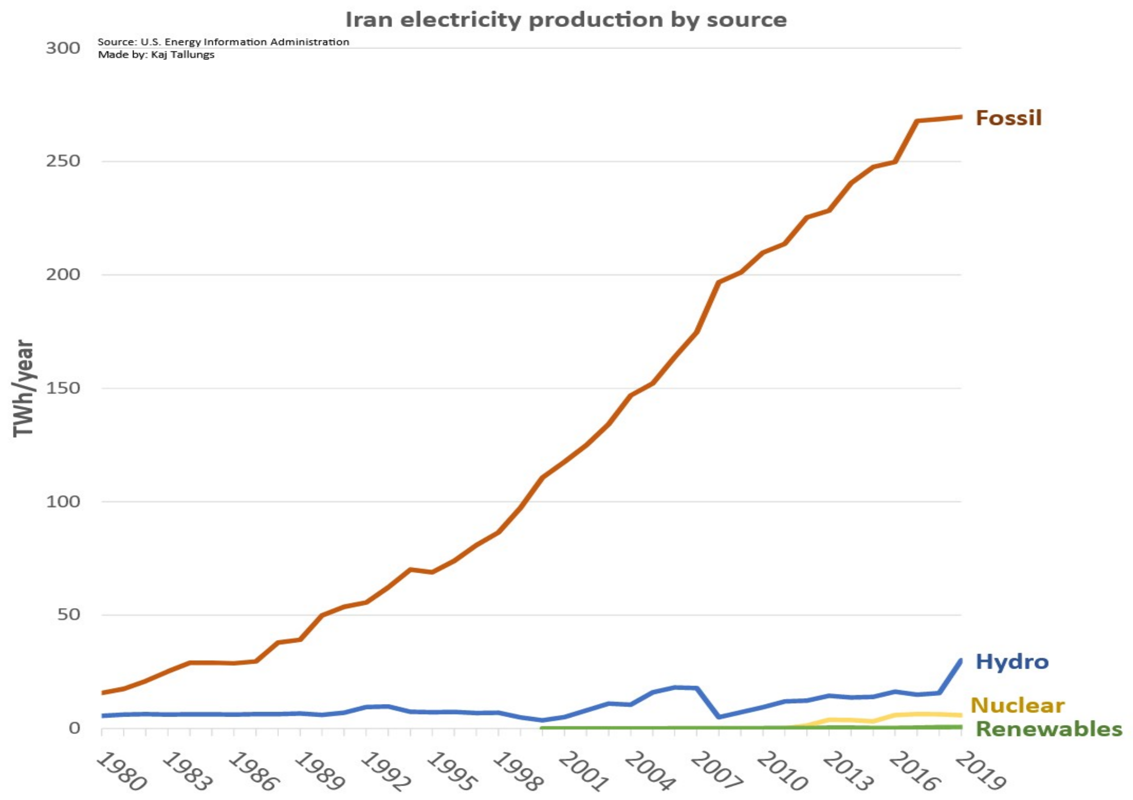
- Gas, Steam and Combine Cycle
- In-use Fuel:
  - Gas
  - Mazut (Fuel oil)
- Both electricity export and import
- Renewable energy (Wind and Solar) has been trending recently.
  - Mapna builds 2.5 MW wind turbine
- At Peak duration
  - 57887 MW Production
  - 58254 MW Consumption
- Need to modify consumption pattern
- Need to build new power plant



Air Cooled Condenser Projects

Classification of Implemented ACC Projects

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- Air Cooled condenser Project Mapna Group
  - 30 feet
    - 5×6 Linear
      - Chadour Malou — Torbat
    - 4×6
      - Abadan
    - 4×7
      - Isfahan II — Genaveh — Kahnouj — Parand — Chabahar — Kashan — Oromiyeh
    - 4×8
      - Behbahan — Sirjan — Samangan — West Karoun — Hormozan — Shamara — Assaloyeh
  - 34 feet
    - 4×6
      - Zanjan
    - 4×5
      - Sabzevar
  - 36 feet
    - 7×7
      - Rudshur

In Operation

Commissioning

Under Construction

Other Specification

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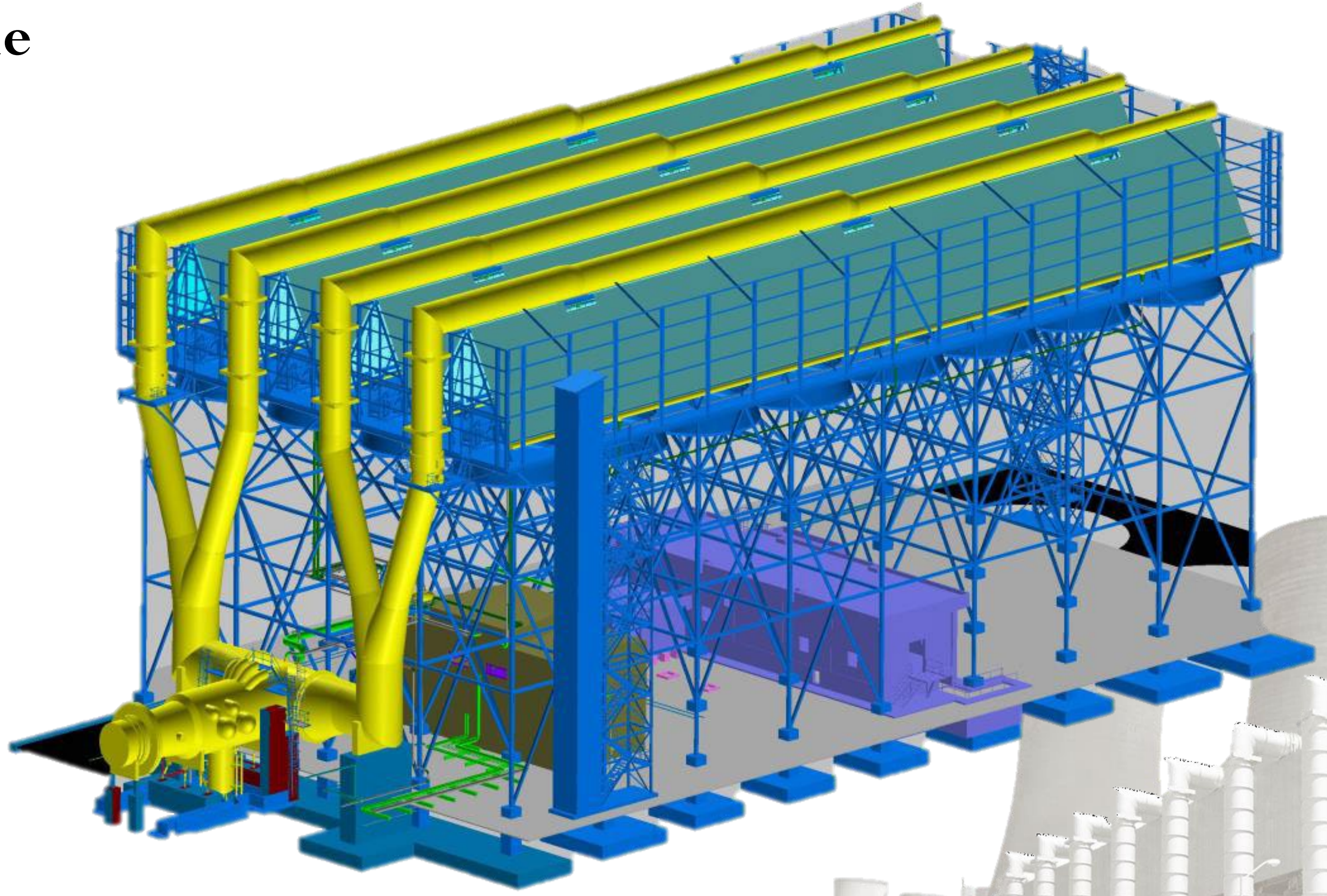
- 20 to 30 °C ITD Range
- Single Row Tube
- 30 to 36 ft. Fan Diameter
- 25 to 30 m platform height
- Double Speed and VFD motor
- Concrete and Steel Column
- Air Evacuation System
  - 1 Hogging Ejector
  - 2 Holding Ejectors

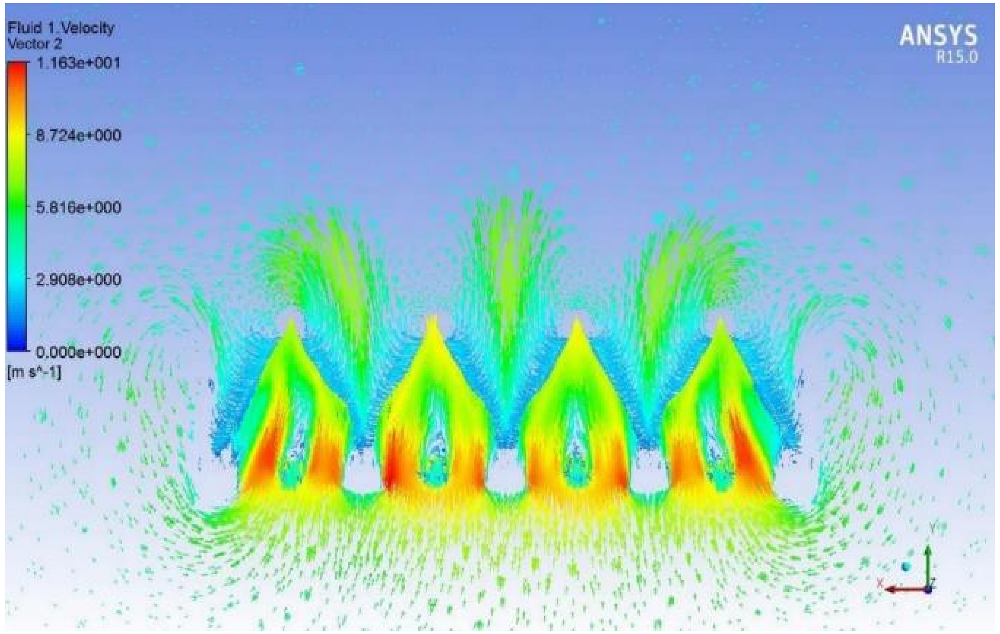
Design Process

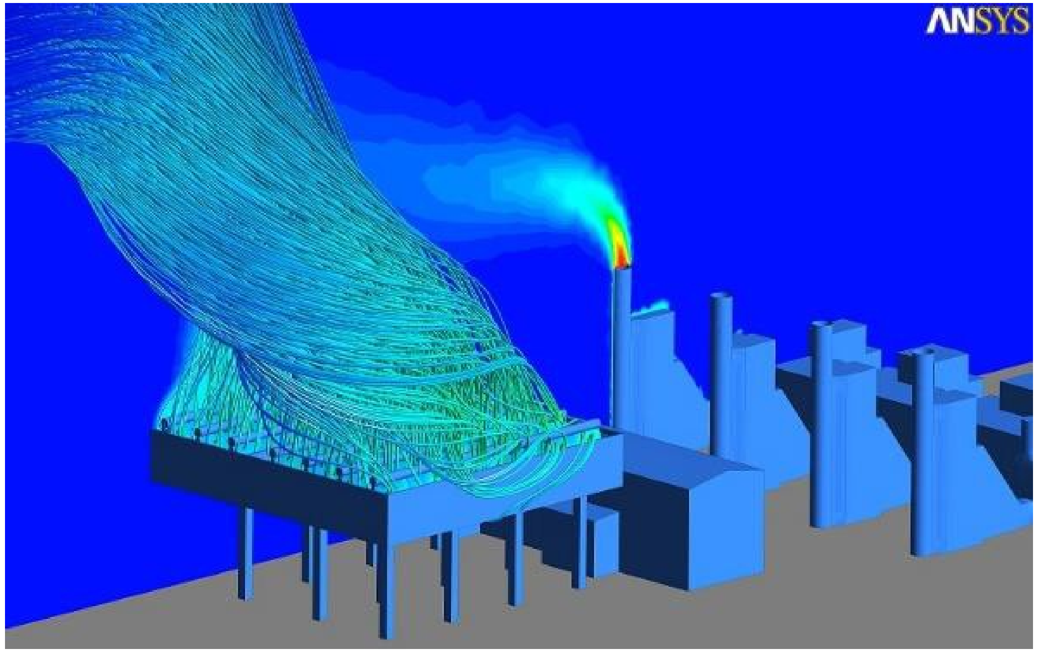
- **Find Optimum Size**
  - **Check different cases at the beginning of each project**



CFD Study

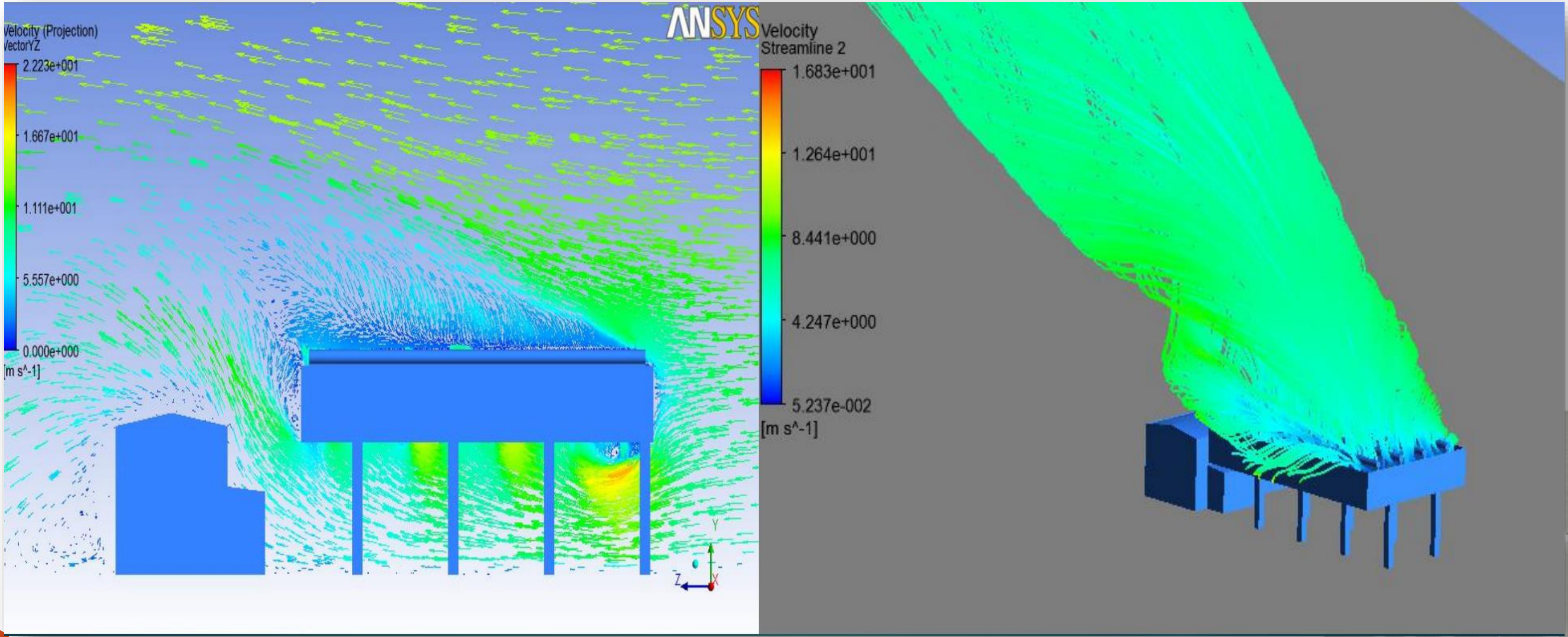
- **CFD Study:**
  - ACC Size
  - ACC arrangement
  - Plant arrangement according to wind direction





CFD Study

- **Affect of other buildings on ACC**



Optimization and Development

High Wind Velocity

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Problem Description:

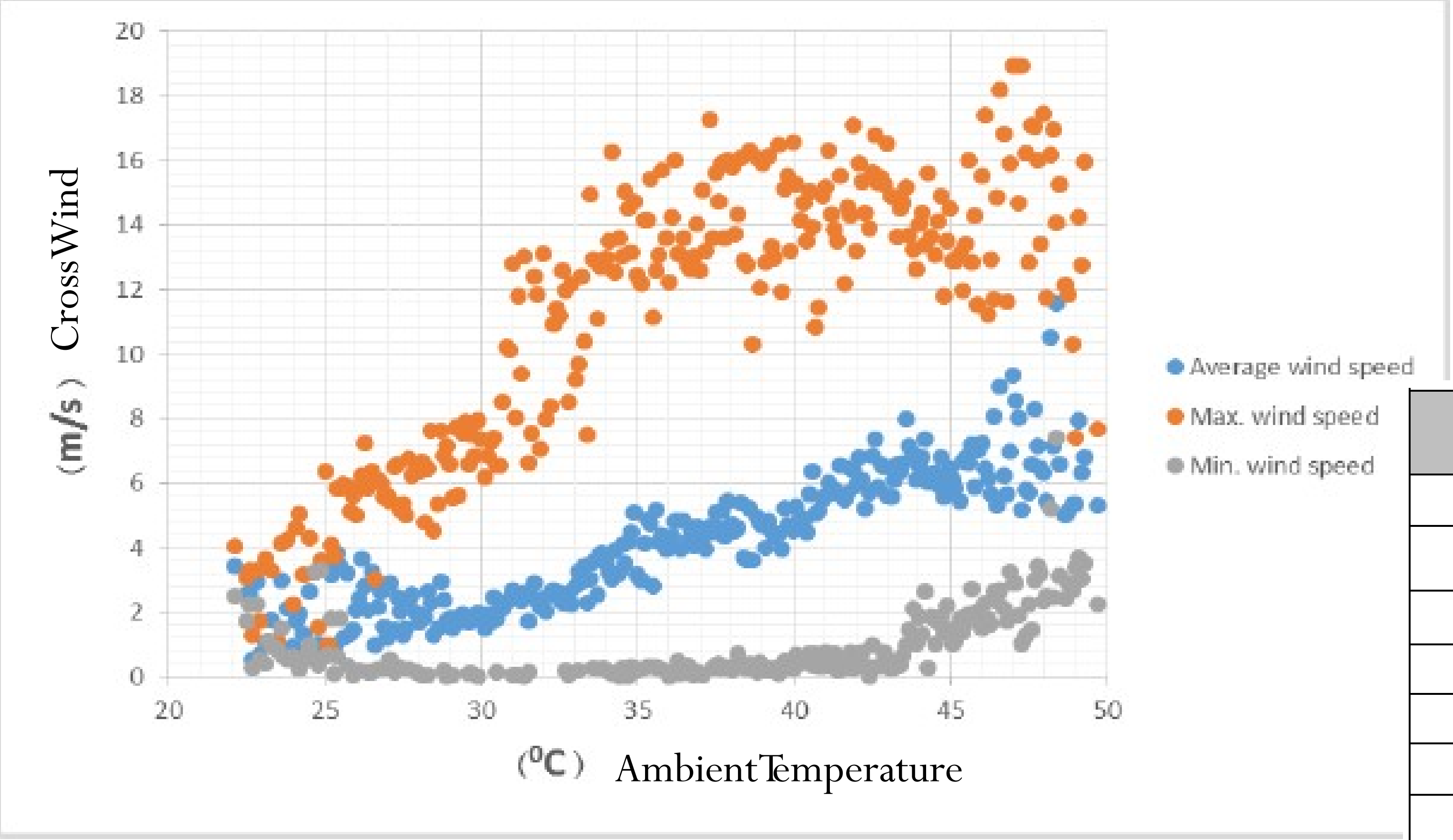
- During Warm Seasons
- Decrease in ACC Efficiency
- Decrease in Steam Cycle Load

Decrease in Load
Because of High Back Pressure

Time	Fan Velocity (%)	Cond. Vacuum (mbara)	Wind Speed (m/s)	Amb. Temp. (^{0}C)	Active Power (MW)	Steam Flow (kg/s)
11:01:00	109.681	366.451	4.71	45.205	126.422	134.829
11:02:00	109.681	365.109	3.115	45.205	126.422	134.829
11:03:00	109.681	359.653	5.355	45.205	126.422	135.889
11:04:00	109.681	366.184	4.1	45.205	126.422	135.889
11:05:00	109.681	363.529	4.745	45.205	126.064	135.043
11:06:00	109.681	378.218	6.61	45.205	126.064	135.043
11:07:00	109.681	389.765	5.035	46.39	124.969	136.102
11:08:00	109.681	389.765	3.845	46.39	116.798	124.427
11:09:00	109.681	377.625	5.48	46.39	110.51	115.339
14:46:00	109.659	352.25	3.37	48.548	84.594	96.084
14:48:00	109.659	350.838	11.655	48.548	84.427	95.784
14:55:00	109.659	351.01	6.145	48.548	85.094	95.749
14:56:00	109.659	359.405	3.505	49.395	85.57	96.725
14:57:00	109.659	355.592	5.68	49.395	85.57	96.725
14:58:00	109.659	365.589	6.615	49.395	84.117	95.295
14:59:00	109.659	365.589	4.24	49.395	84.117	94.51
15:00:00	109.659	355.539	15.965	49.395	84.117	95.57
15:13:00	109.659	367.909	11.84	48.28	83.641	94.494
15:14:00	109.659	357.57	5.21	48.28	85.356	95.624
15:15:00	109.659	360.127	7.085	48.28	85.356	95.624
15:16:00	109.659	356.005	5.34	48.28	85.356	95.661
15:17:00	109.659	356.005	13.455	48.28	83.974	94.819
15:18:00	109.659	352.228	5.24	48.28	83.974	94.819
15:20:00	109.659	359.901	12.32	48.28	85.88	95.656
15:21:00	109.659	355.985	16.18	48.28	84.689	95.678
15:22:00	109.659	355.985	9.73	48.28	83.831	94.841

High Wind Velocity

CrossWind Analysis



Design Specification

Description	Value
T_{design}	24.5 °C
ITD_{design}	29 °C
RH_{design}	63 %
Wind $Veocity_{design}$	3 m/s
Site Elevation	17 m
ACC Heat Load	317.4 MWth
HRSG Run back setpoint	400 mbara
Turbine trip setpoint	500 mbara

High Wind Velocity

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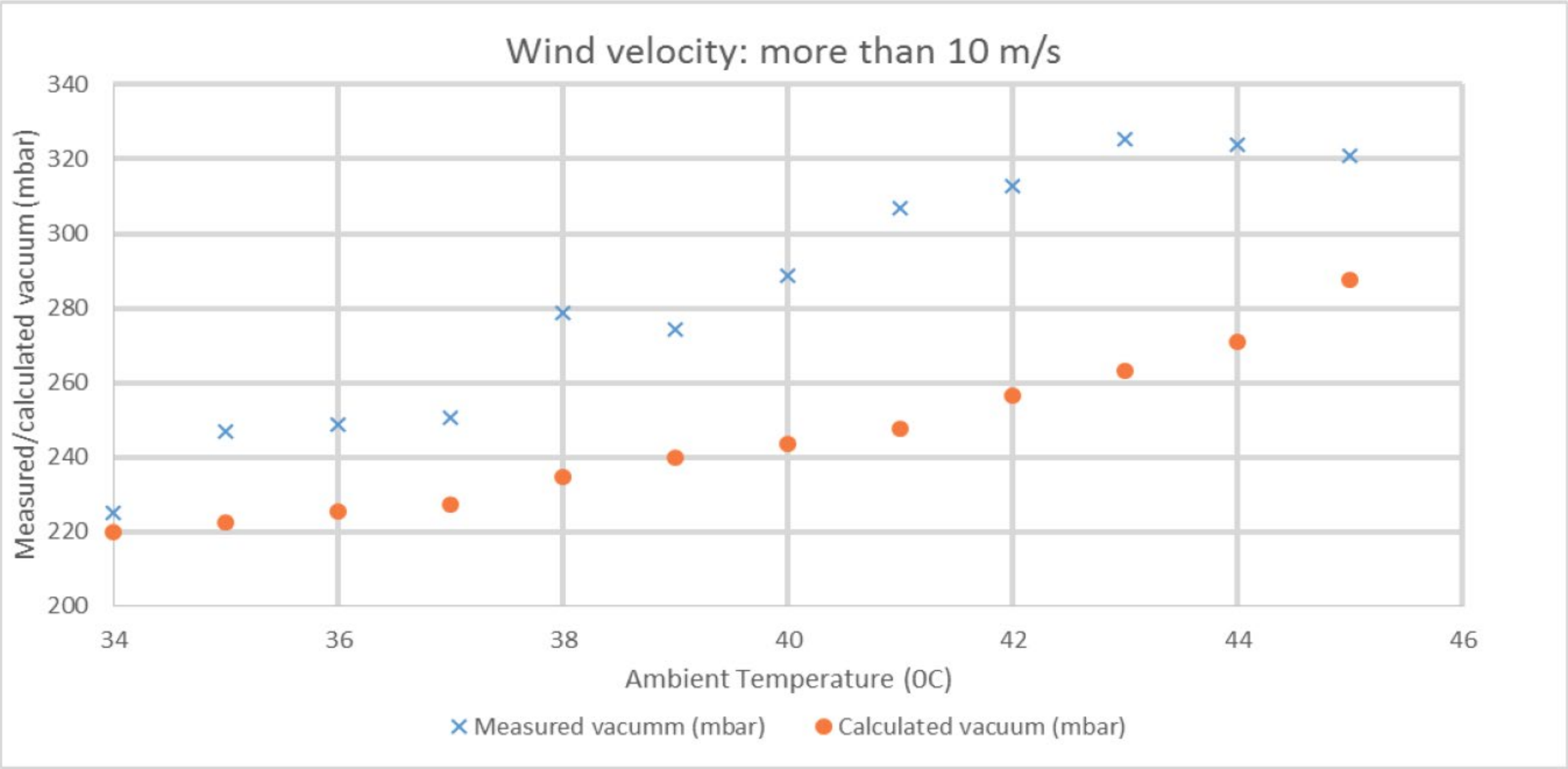
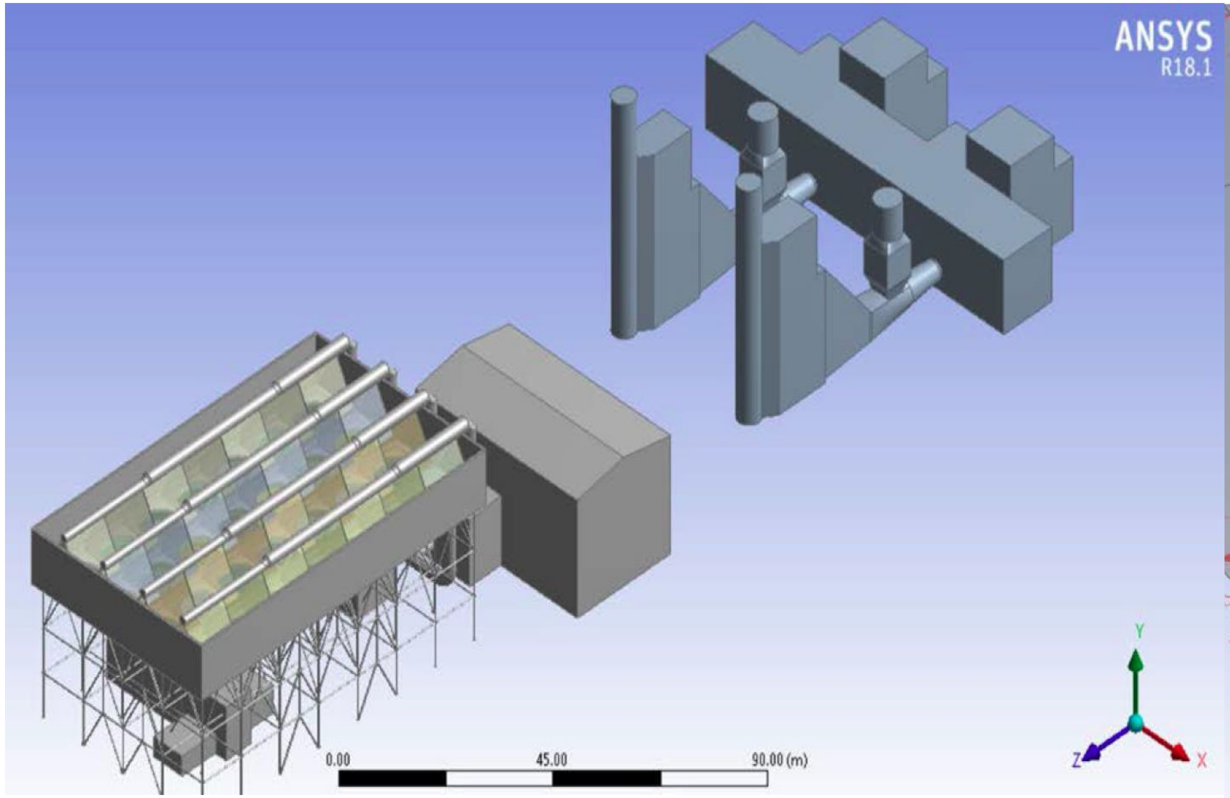
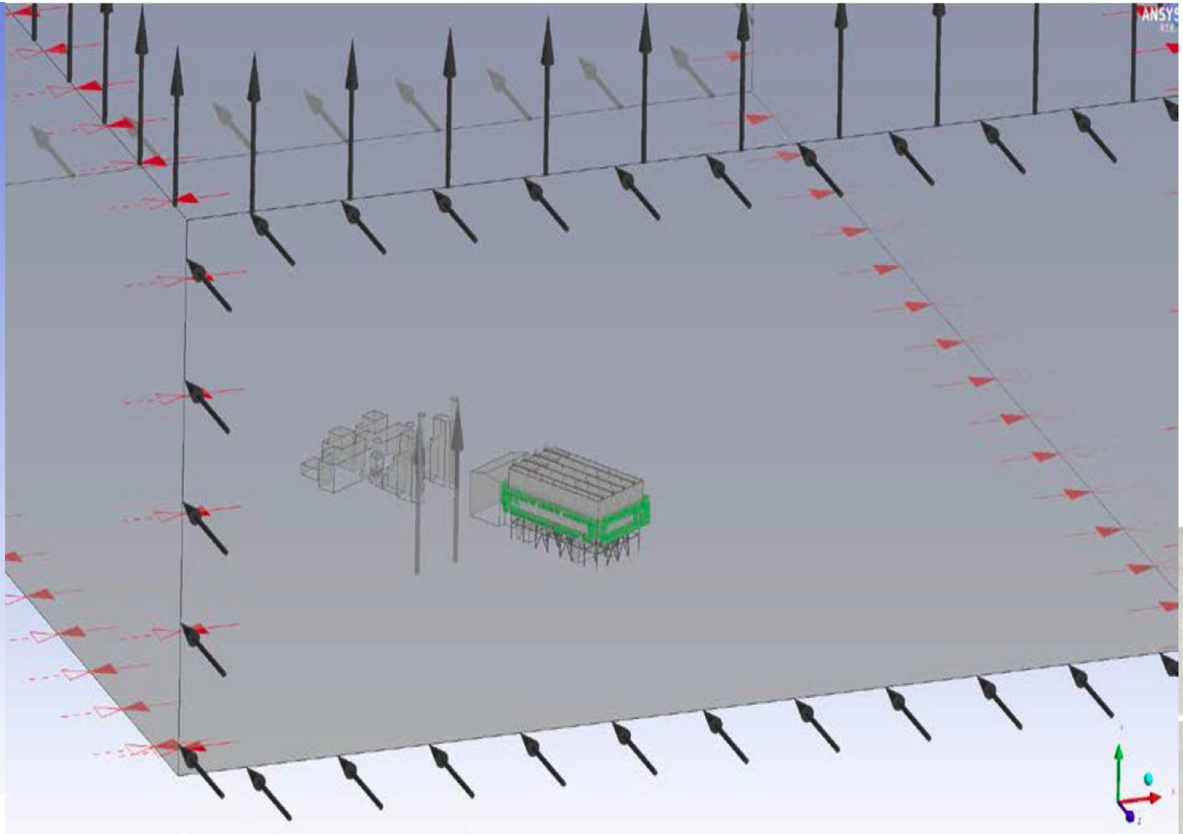
Back-Pressure Analysis



Wind Screen

CFD Analysis and Define Geometry

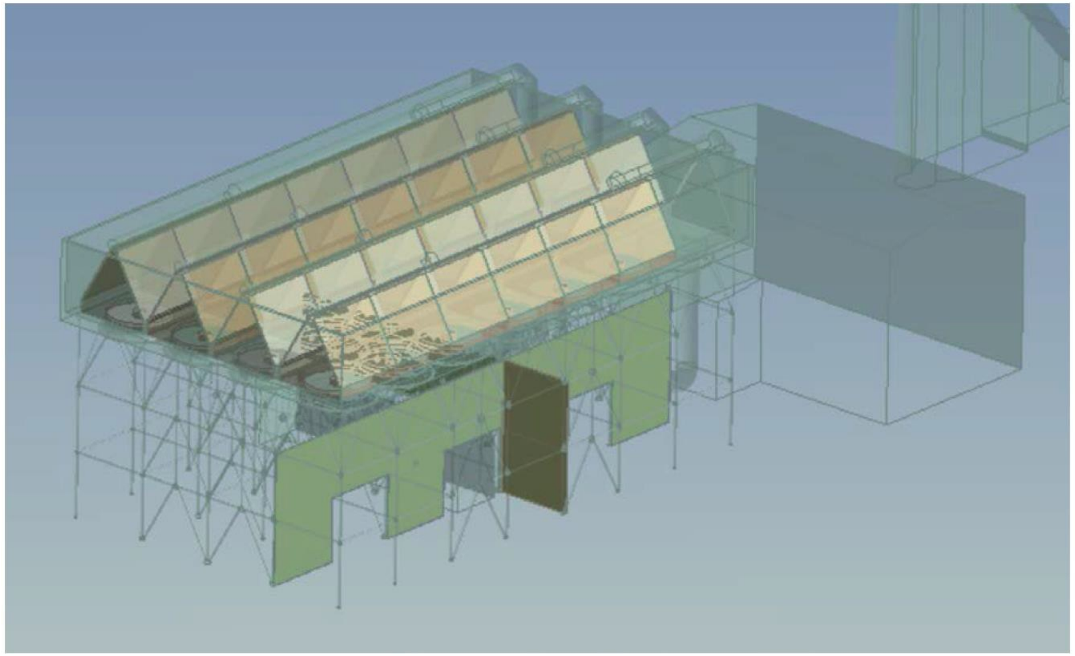


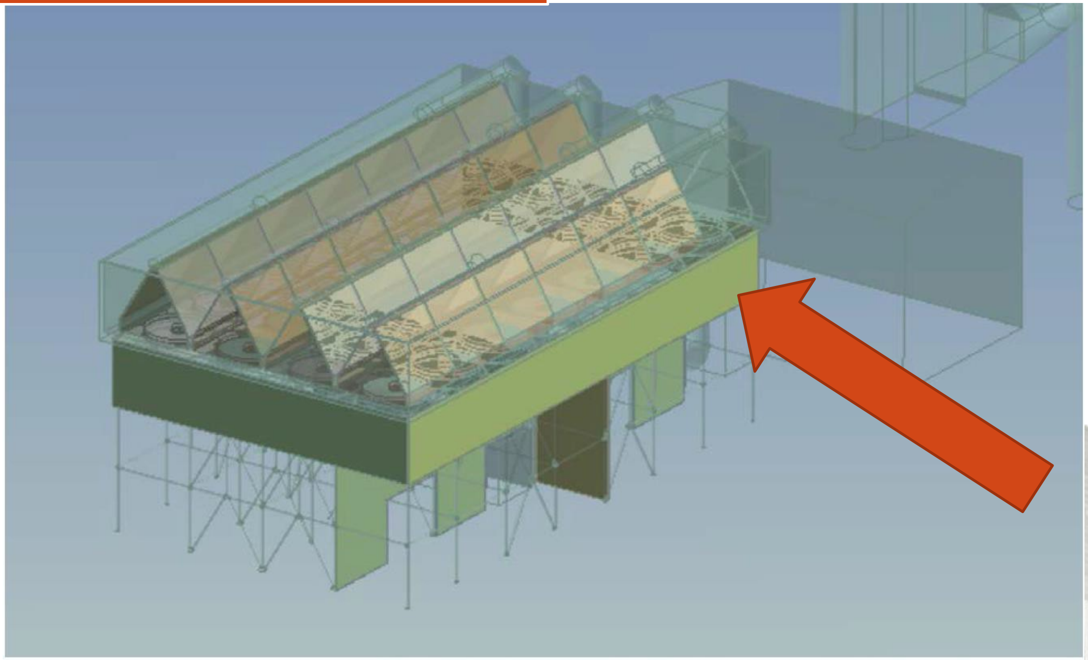


Wind Screen

Wind Screen

Cruciform | Perimeter plus cruciform





Case	Number of elements
Cruciform wind screen	33083099
Perimeter plus cruciform wind screen	37343574

Wind Screen

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CFD analysis:

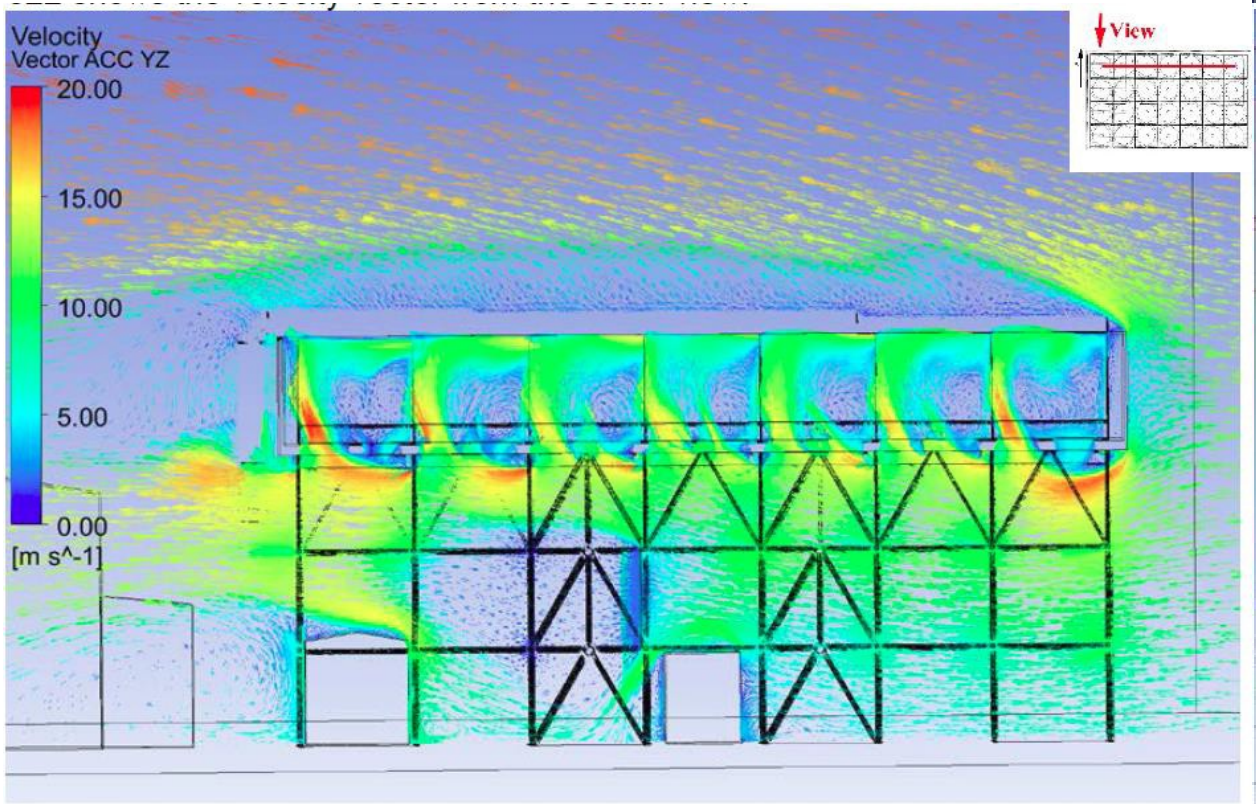
Study Six Cases with two different kinds of WIND SCREEN:

@ 40 C ambient temperature

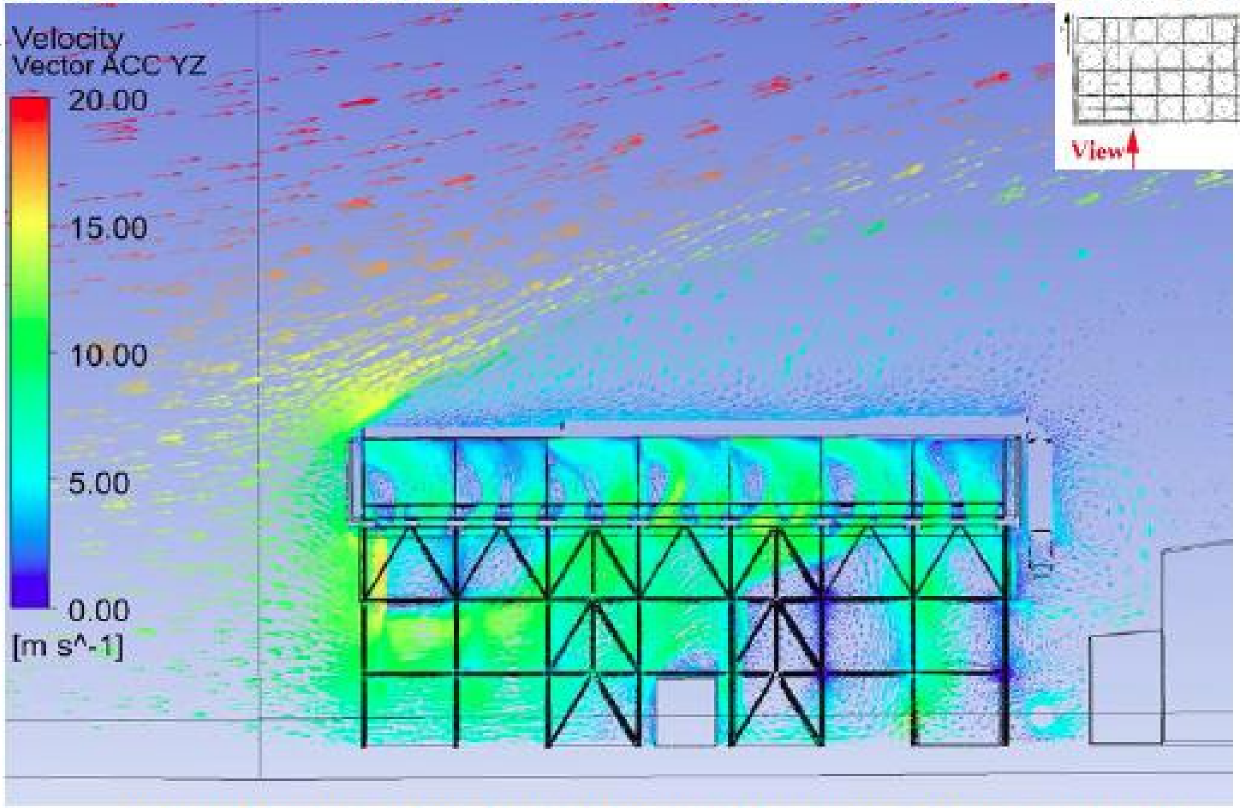
Case	Wind Speed	windscreen
1	0	Cruciform
2	10 m/s	Cruciform
3	20 m/s	Cruciform
4	0	Perimeter plus cruciform
5	10 m/s	Perimeter plus cruciform
6	20 m/s	Perimeter plus cruciform

Wind Screen

CFD Result:



e22 Velocity vectors colored with velocity value, Case3, View from South.



3 Velocity vectors colored with velocity value, Case6, View from North.

Wind Screen

CFD Result:

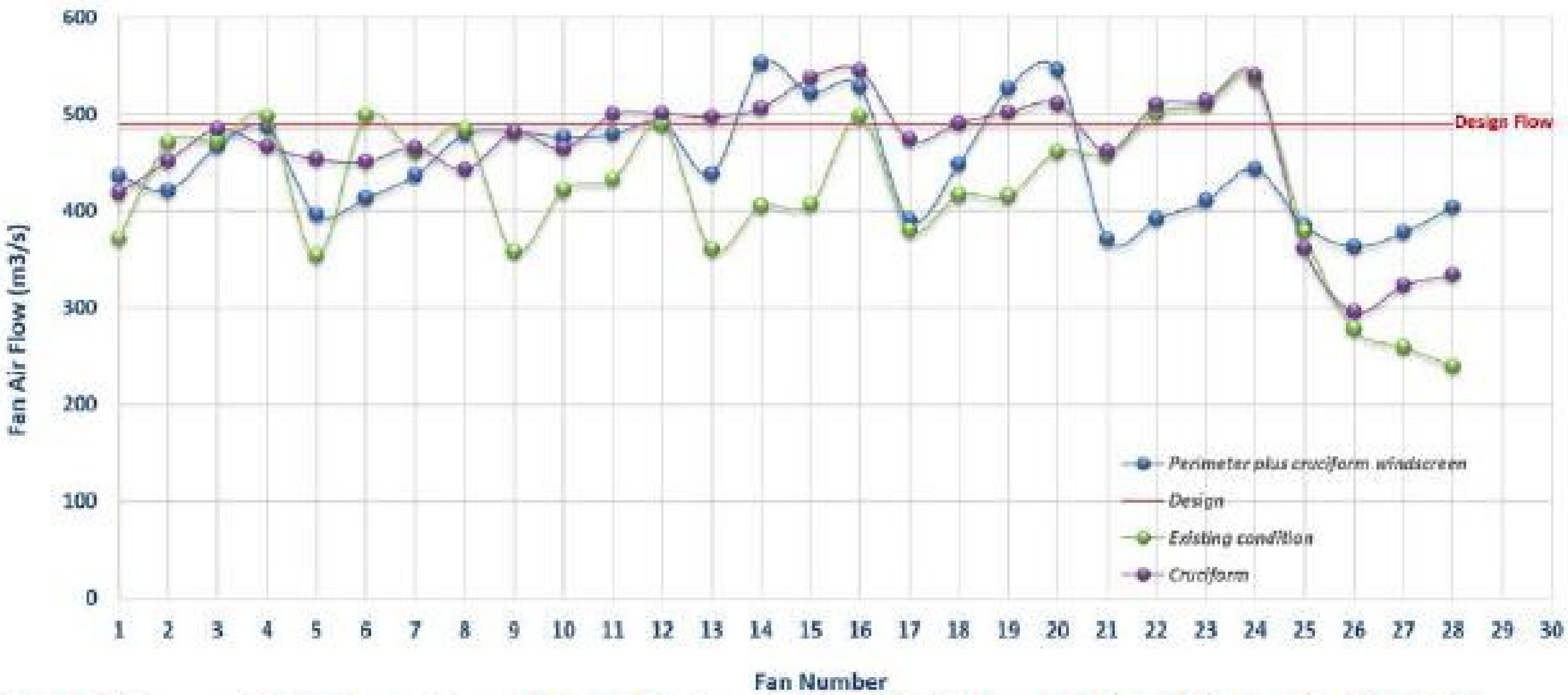


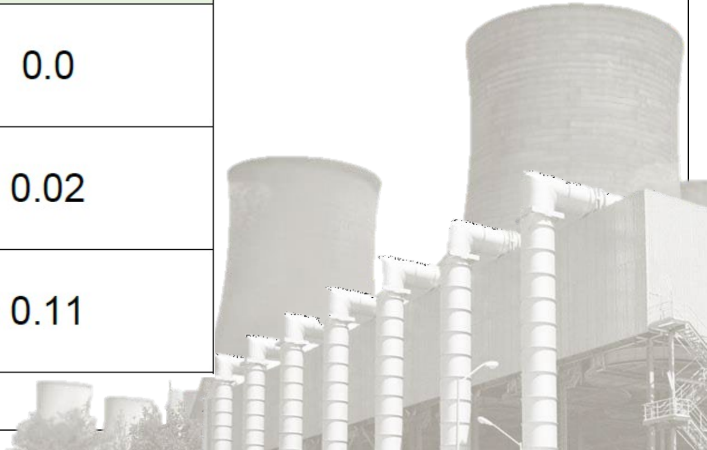
Figure51 Air volume flow of Case3, Case6 and existing condition (Wind velocity: 20 m/s).

Wind Screen

Conclusion:

- Windscreen eliminates hot air recirculation phenomenon even at high wind velocity.
- Windscreen makes a uniform flow for all of fans. As a result, the vibrations of ACC structure will be reduced.
- Windscreen reduces the inlet velocity fluctuations. As a result, the force is lowered into the blades.
- The existence of windscreen prevents the work of fans close to the stall condition. As a result, all fans are in the safe region

Wind Speed (m/s)	Fans average flow relative to the design flow (%)		Temperature difference relative to ambient temperature (^{0}C)	
	Existing condition	Perimeter windscreen	Existing condition	Perimeter windscreen
0	95.3	96.4	0.0	0.0
10	88.5	87.6	0.1	0.02
20	86.2	85.7	2.7	0.11



Ejector

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Design Temperature Difference: more than 20 °C

1st Stage of condenser shell side has a constant temperature

High steam turbine backpressure = High condenser drain temperature (Cooling Water)

Disadvantage:

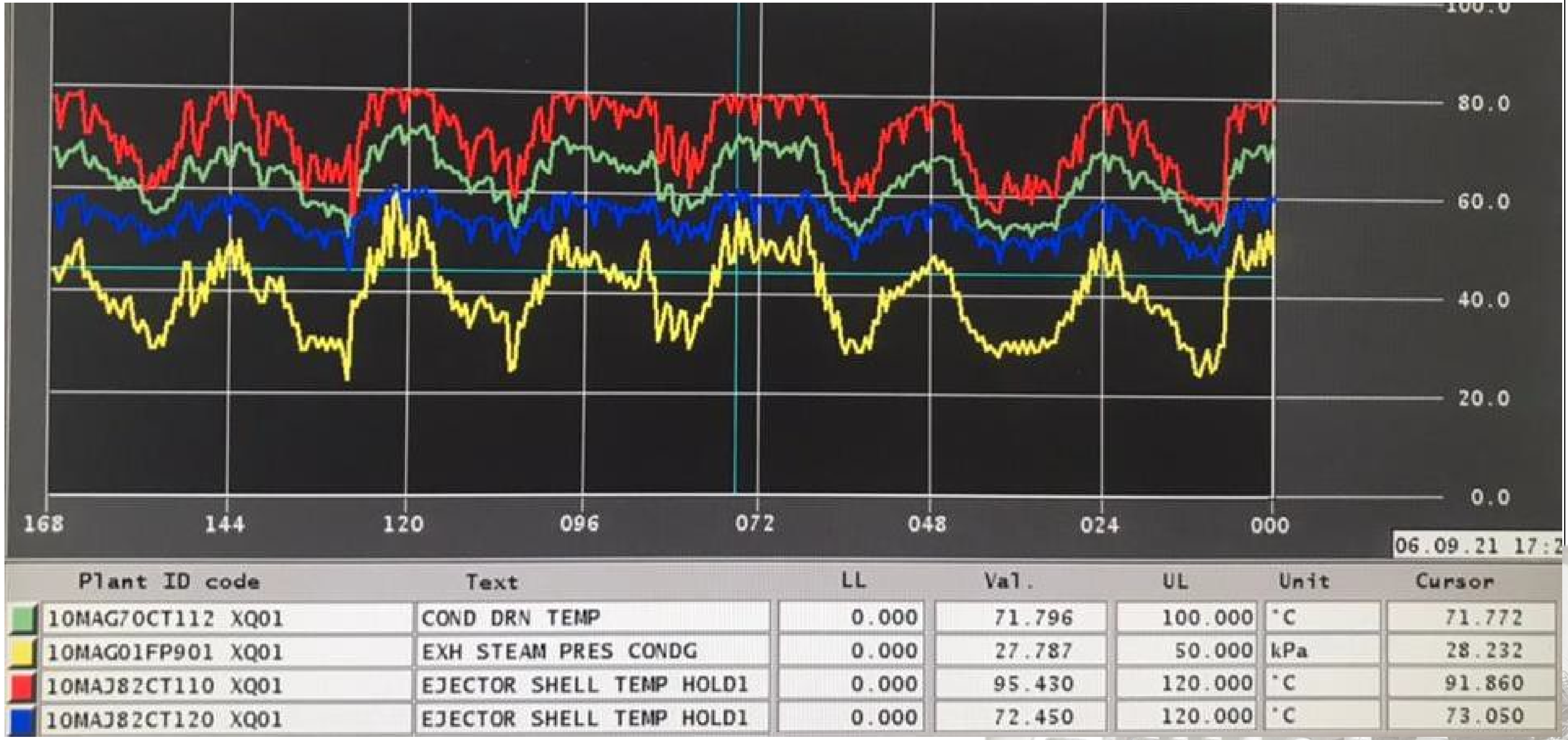
Use Hogging!!

Decrease power plant load!!

Solution:

Turn off 1st stage motive steam valve

Re-design of 2nd stage nozzle



Cleaning

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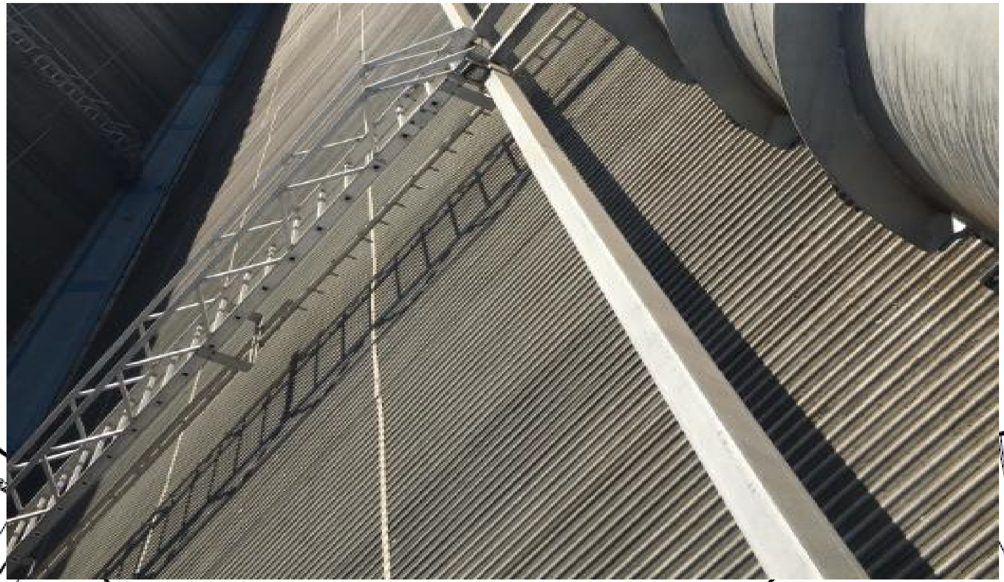
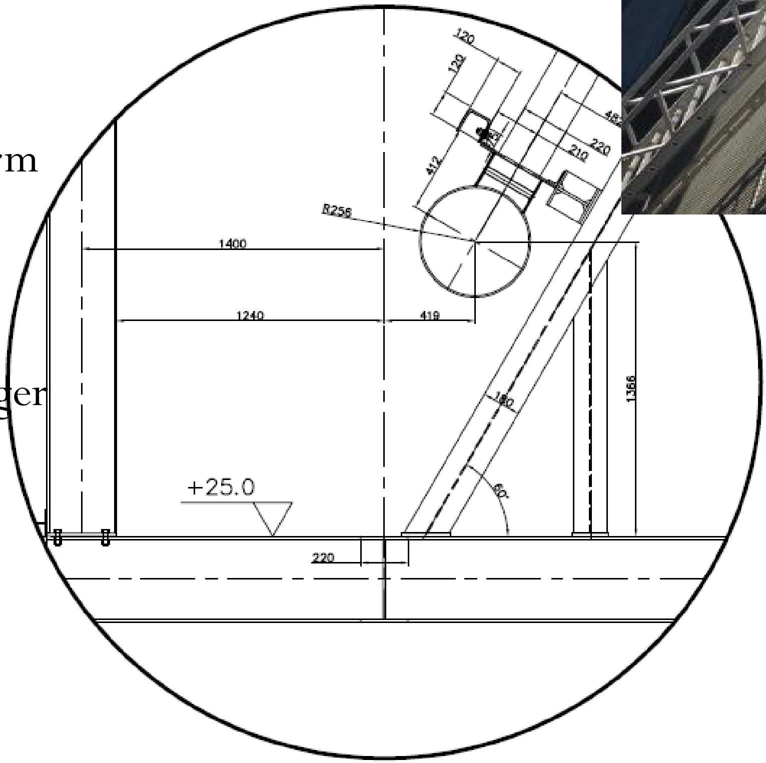
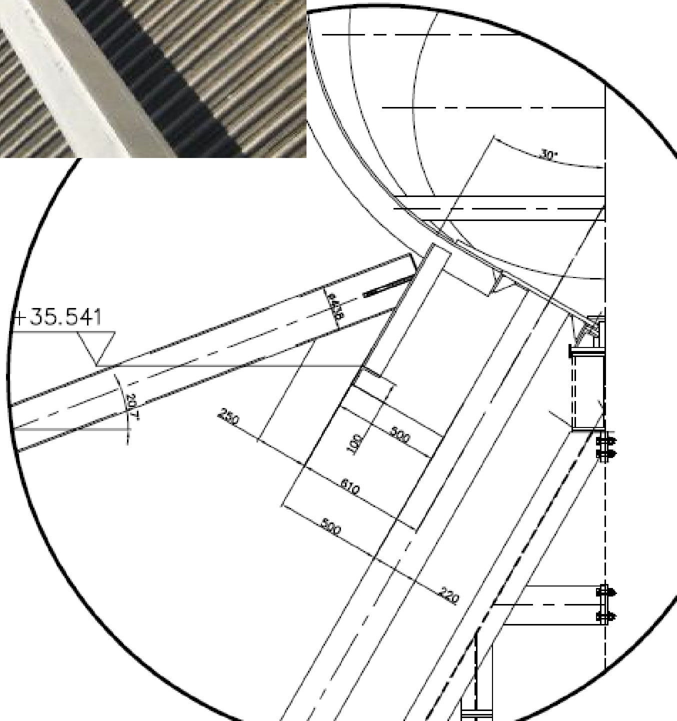
- Due to installation issues and unbalance cleaning rails
- Improper and un-safe movement of cleaning rig
- Falling down of ladder

Solution:

- Change below rail form
- Change connection
- Use tube bundle Hanger

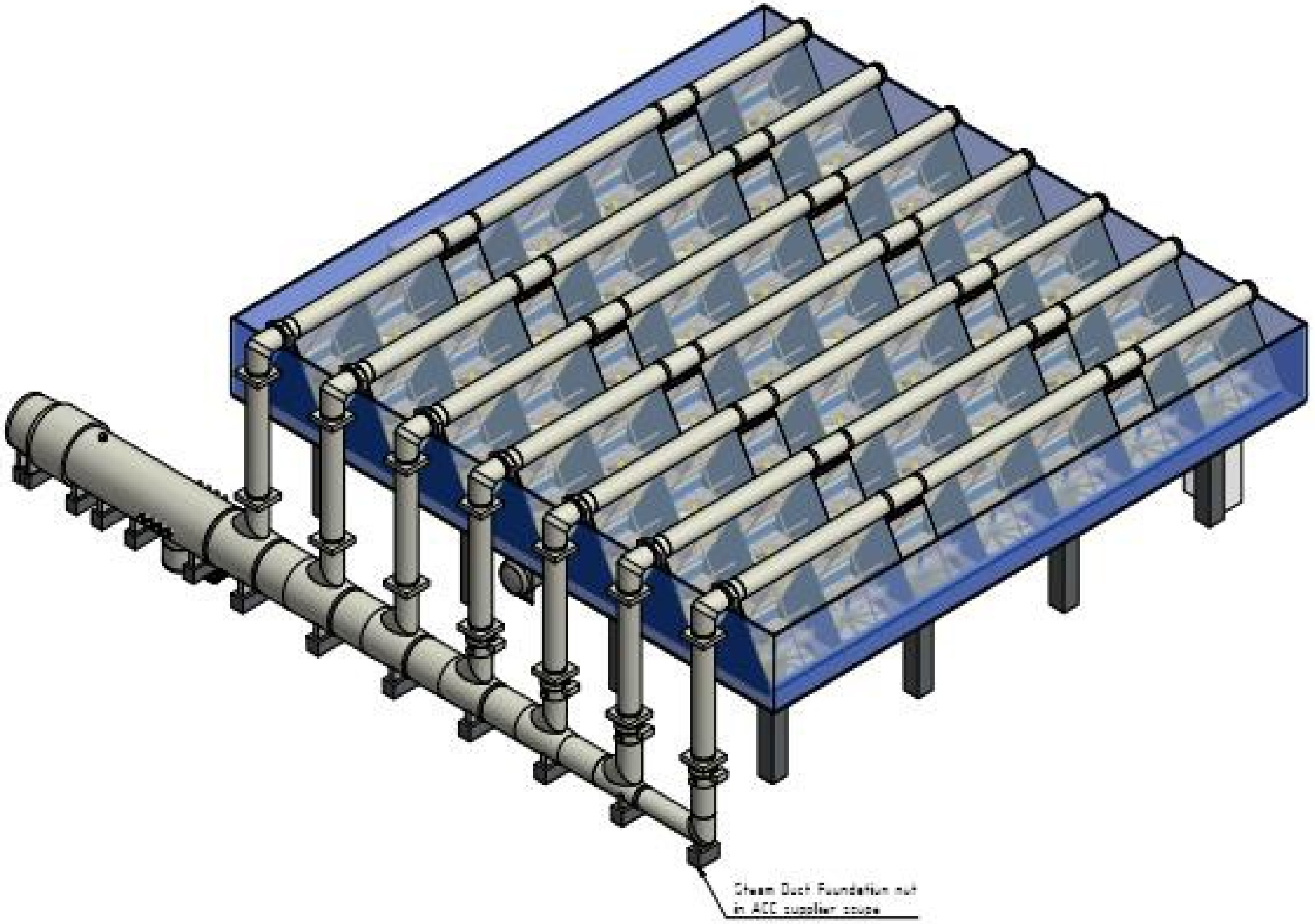






Optimization of Linear Duct

- Specially on Rudshour Project (7*7 modules)
- Optimize and Locating
  - Support
  - Guidvane
  - ….



Challenges and Obstacles

Future Vision

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- Completed
- Under Construction
- Goals

Different Cooling Systems

- 25 to 350 MW Steam Turbine
- Heller
  - Steel
  - Concrete
  - Forced
  - Natural
- ACC
  - A Frame
  - V Frame
  - 30 to 36 feet
  - Steel and Concrete Columns
- Hybrid
  - Combined with Heller
  - Combined with ACC
  - Combined with Forced Heller
- Once Through
- Hexa System
- Aux System
  - V type with Deluge
  - Fin Fan Cooler without Water Spray

V Frame

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Hybrid System with ACC

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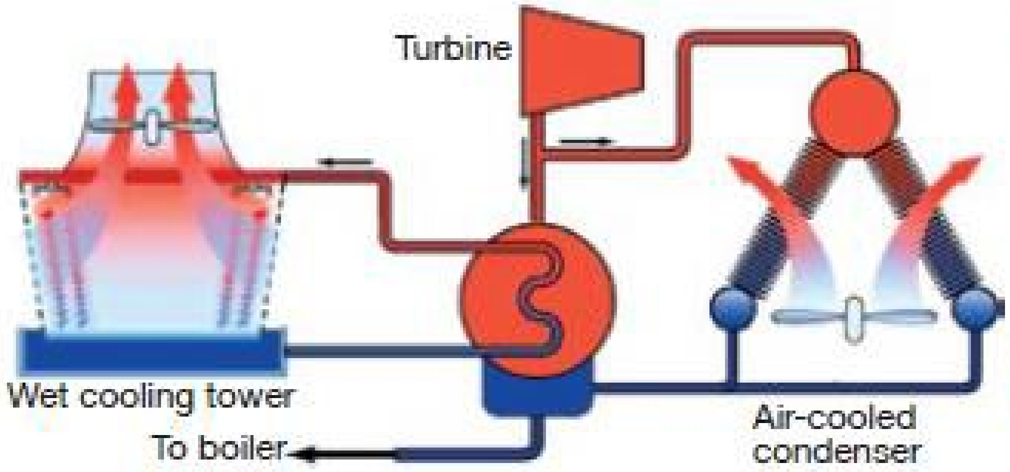

3. Hybrid cooling (wet and dry) is illustrated conceptually at the left, in service at right

Cooling System of Other Plants

- Get involved in replacing wet cooling Systems in:
  - Steel Company
  - Petrochemical
  - Refinery
  - ….

Conclusion and Future Work

- Our Requirement
  - The latest updates and optimization
  - V Frame Technology
  - New Hybrid Development
  - …

- Our Features and Capabilities
- Design, Procurement and Construction Service of Air Cooled Condenser
  - Optimization Service
  - Engineering Software Service:
    - 3D modeling, CFD, Piping, …

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Thank you