CIRCULATION ANALYSIS FOR BOILER
ENGINEERING SERVICES FOR POWER PLANTS AND ENERGY SYSTEMS

Reticom Solutions
Measure, Monitor, Manage

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In boilers which have drum, the steam generation in evaporator is achieved by water/steam circulation circuit.

**Source of Driving Force:**
- Forced Circulation: Pump
- Natural Circulation: Buoyancy Force

The buoyancy force is generated by difference in density in left and right branches due to the amount of steam generated in evaporator tube.
In order to protect tubes from overheating, the steam quality needs to be limited at the tube outlet.

- $m$: Steam production rate
- $\dot{M}$: Circulating flow rate
- $0 \leq x \leq 1$: Steam quality at the tube outlet
- $CR = \frac{1}{x}$: Circulation ratio

Coupled thermo-hydraulic calculation is needed in a try-and-error loop.
CHALLENGES

Challenges to Solve Boiler Circulation:

- Complicated geometry
- Different pressure drops of branches
- Different heat absorption rate for tubes due to gradual temperature decrease in flue gas
- Non-uniformity in flue gas temperature
- Instability of calculation, specially for low-pressure drum conditions
FEATURES OF CIRCULATION SOFTWARE

- Flexible to simulate complicated arrangements
- Easy to input geometry details
- Able to calculate natural/forced circulation
- Customizable design criteria
- Non-uniform heat absorption rate is applicable
- Auto-sizing of pipes and tubes based on input criteria
FEATURES OF CIRCULATION SOFTWARE

- Estimation of FAC risk in tubes and risers
- Quick Estimation of weight/volume/price
- Performs parameter study
- Calculation of flow properties in all branches
- Distribution of water/steam properties along a single tube
- Providing user-control on numerical method
SAMPLE OF RESULTS

- Calculation of flow features in all branches
- Reporting high-risk branches
- Easy to modify configuration
SAMPLE OF RESULTS

- All properties of flow in branches will be calculated.
- Weight and volume of pipes and tubes are calculated.
Even more details!
- Distribution of all parameters along a single tube
- Highlighting risky regions due to FAC
- Water/steam properties at each tube cross-section
- Metal temperature at each tube cross-section
- Finding hot spot regions