A Dual Compartment Chimney Tray

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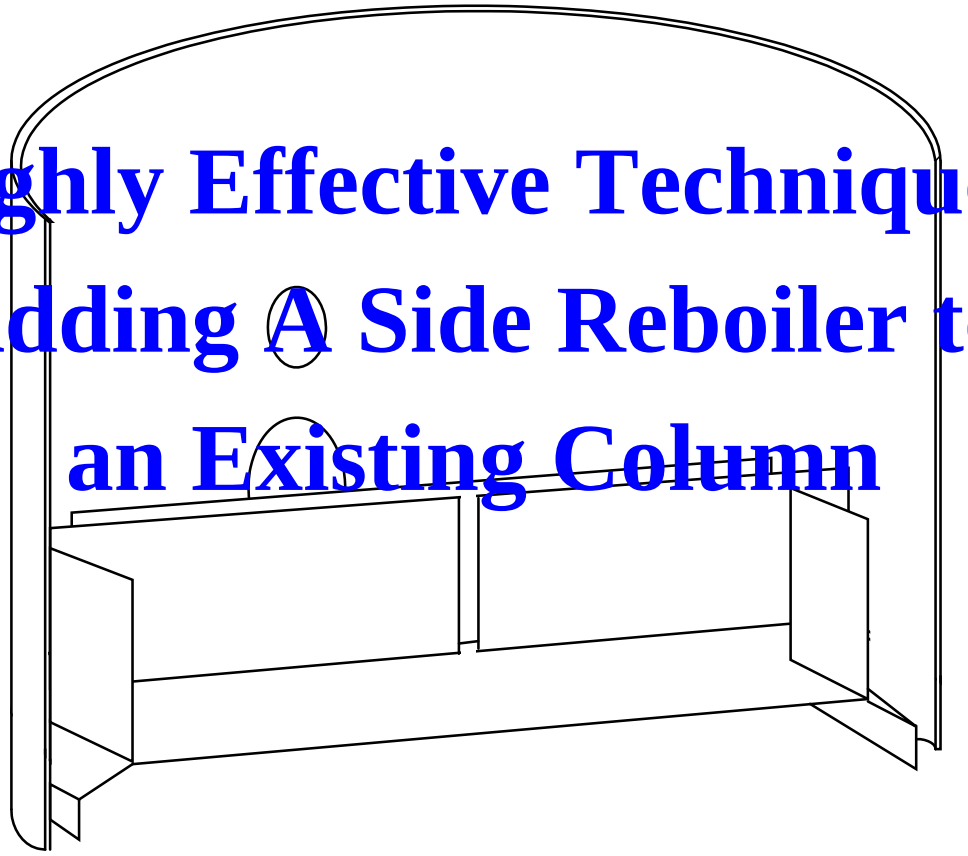

A Highly Effective Technique for Adding A Side Reboiler to an Existing Column

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History of the Hydrocracker Unit

- Built in 1962 for a capacity of 8,800 BPD
- Revamped in 1971 to a capacity of 11,200 BPD
- Revamped in 1992 to a capacity of 17,500 BPD
- Now running at 22,000 BPD

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Debutanizer Revamp in 1971

- Reused the existing 3-pass trays in the bottom section of the Debutanizer
- Added a pumped side reboiler loop to recover heat from the reactor effluent
- Installed 3 x 12” draw-off nozzles at tray 25 and piped to side reboiler pump suction
- Installed 3 x 8” distributors and one 8” and one 10” return nozzle at tray 25

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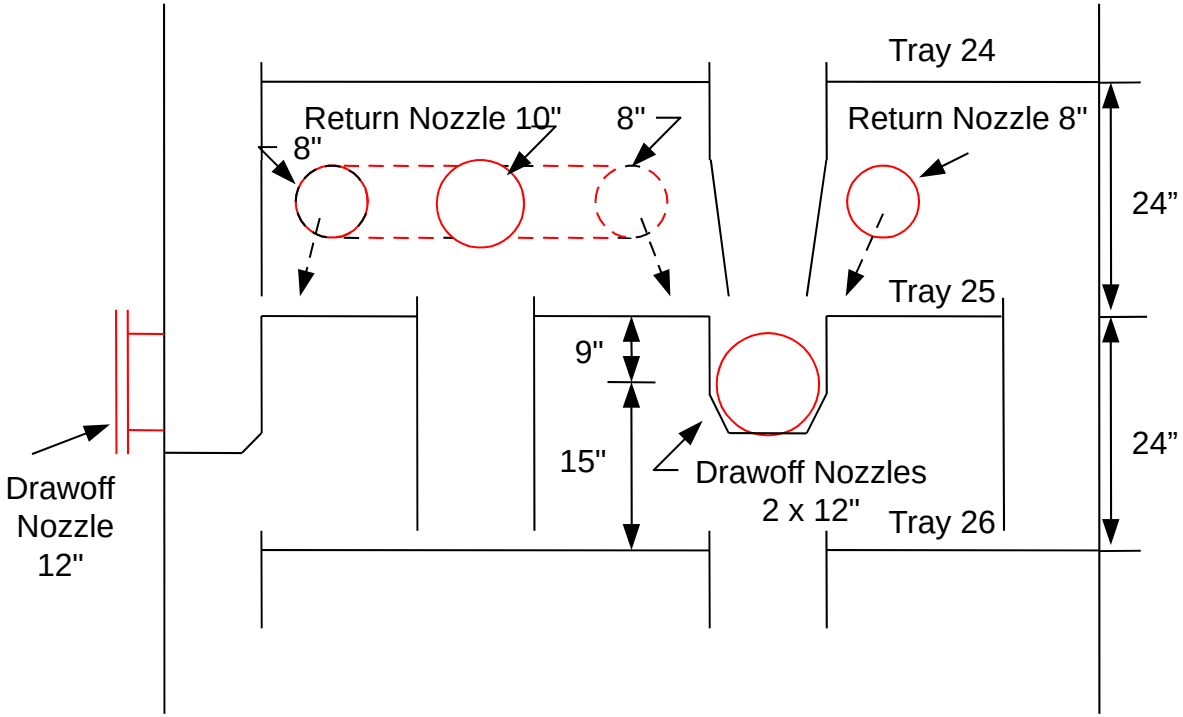
Side View of the Side Reboiler Drawoff and Return Nozzles Installed in 1971



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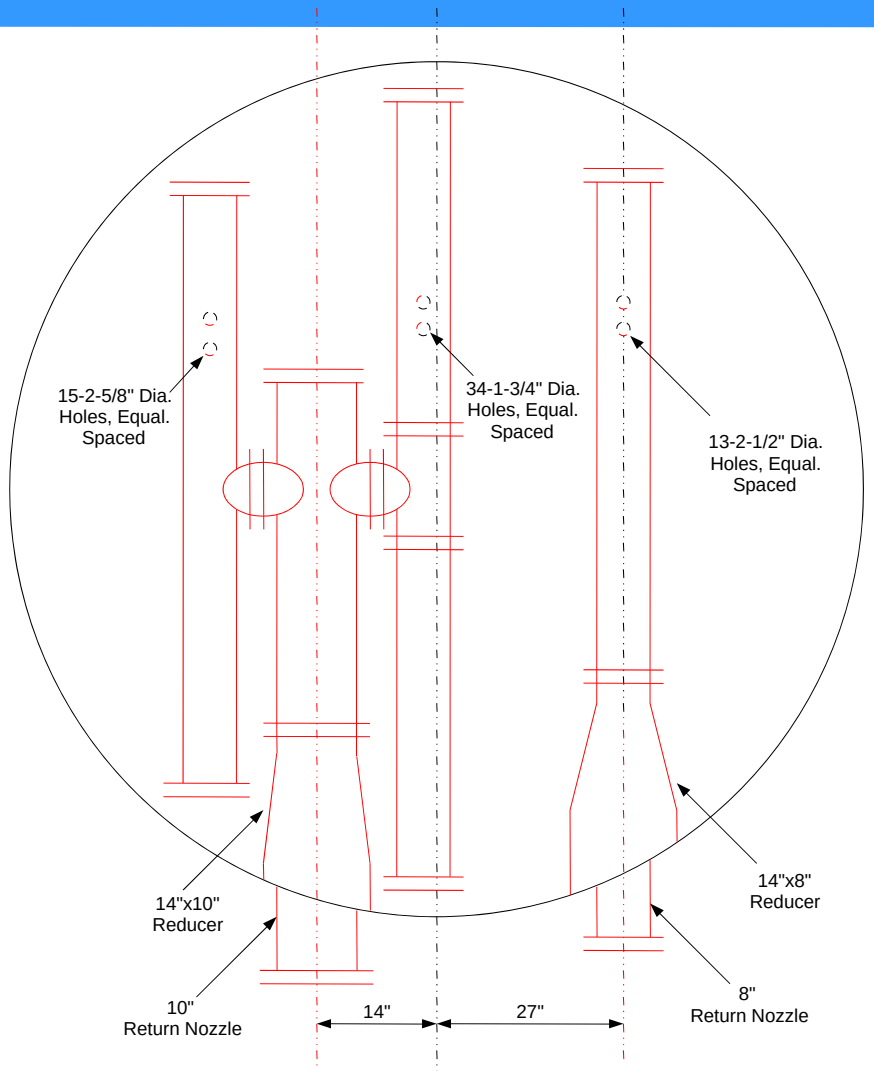
Top View of the Side Reboiler Return Distributors and Nozzles Installed in 1971



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Problems

- Side reboiler pump cavitates at 2/3 of the rated flow of 42,000 BPD, or at about 28,000 BPD
- Debutanizer performance doesn’t meet the 1971 revamp requirements
- Side reboiler feed stream is a “mixed” stream consisting of side reboiler return and liquid from tray 24 (loss of LMTD)

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Causes of Side Draw Limitations

- Poor Drawoff Tray Design
  - Uneven drawoffs in a 3-pass tray
  - Inadequate degassing of the boiling liquid
- Poor Side Reboiler Return Design
  - Uneven side reboiler return to each flow pass
  - Inadequate segregation of cold and hot fluids
- Poor Mixing of Fluids
  - Fluid mixing on the deck and troughs
  - No assurance of fluid flow direction

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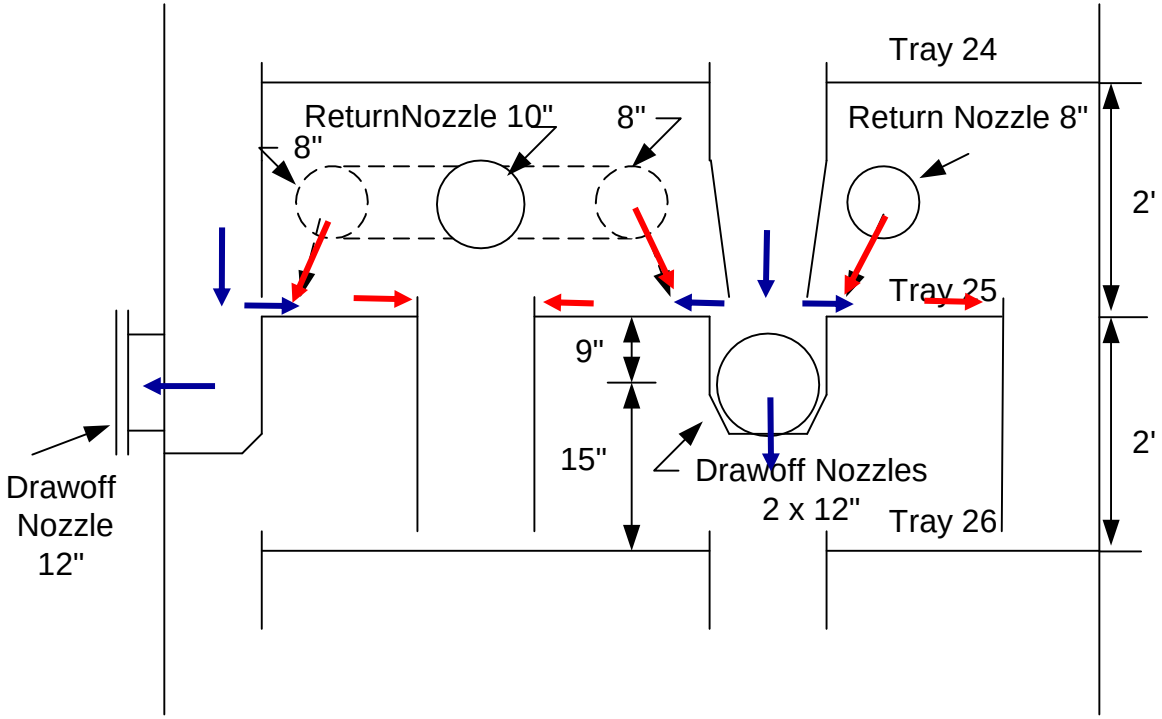
‘Idea’ Hot Fluid Flow Direction



Drawoff Rate < 28,000 BPD

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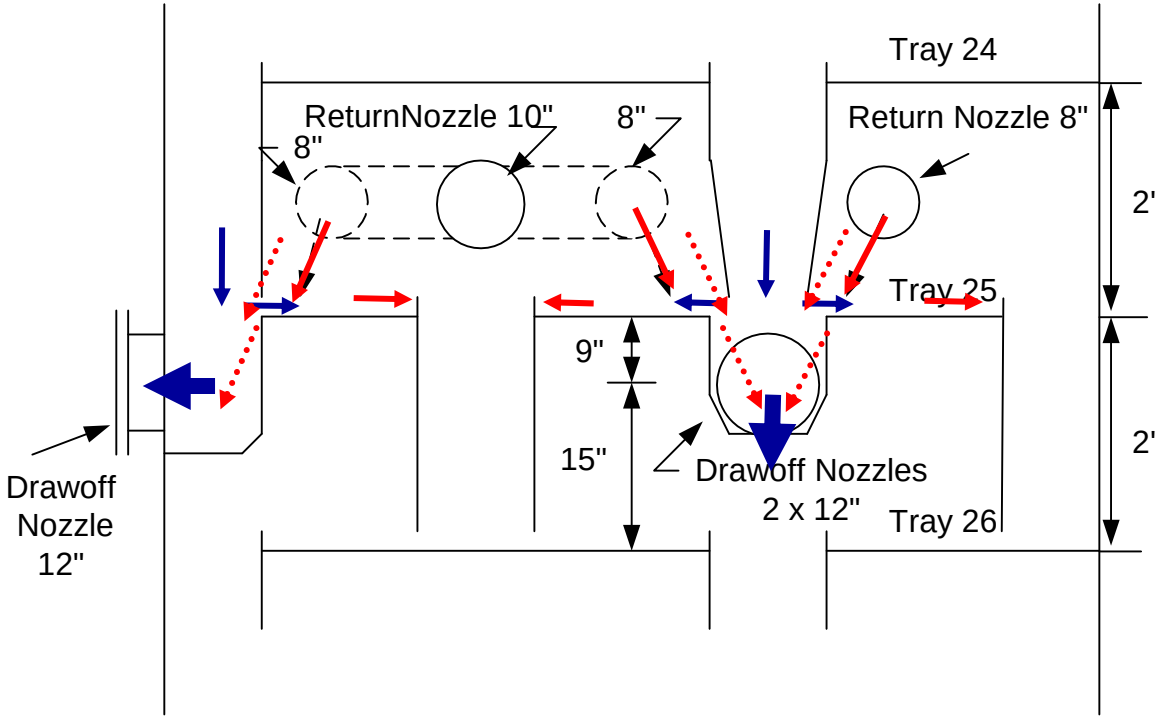
‘Actual’ Hot Fluid Flow Direction



Drawoff Rate > 28,000 BPD

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Process Design Objectives

Design a Dual Compartment Chimney Tray to perform the following tasks:

- Cold fluid surge for pump drawoff
- Hot fluid surge for liquid stabilization and degassing prior to flowing to tray below
- Side-reboiler return vapor/liquid separation
- Isolation of the cold fluid for a better LMTD
- Vapor chimney for vapor from the tray below

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Column Design Limitations

- Limited free vertical space for a chimney tray and pump liquid surge.
- How to control a 90 to 95% drawoff of cold fluid without a level or flow controller?
- How to prevent the cold fluid from being mixed with the hot side reboiler return fluid?
- How to safeguard the pump?

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Innovative Solution

A Dual Compartment Chimney Tray with A Special *Double Wall*

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Process Innovations

- Install a special ***double wall*** partition for separating the cold and hot compartments
- Isolate the cold fluid and allow excess cold fluid to sweep inside the ***double wall***
- Reverse hot fluid flow as an emergency backup for pump protection
- Use temperature sensors to indicate the fluid flow direction on the chimney tray

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Chimney Tray Features

- A new 20” pump draw nozzle designed for automatic degassing
- A new 10” U type side reboiler return distributor and a new nozzle
- A vapor chimney of 27” X 40” X 43”(High)
- A 32”(High) ***double wall***
- Two tray 26 downcomer chutes
- Two 29” (High) liquid dams to tray 27

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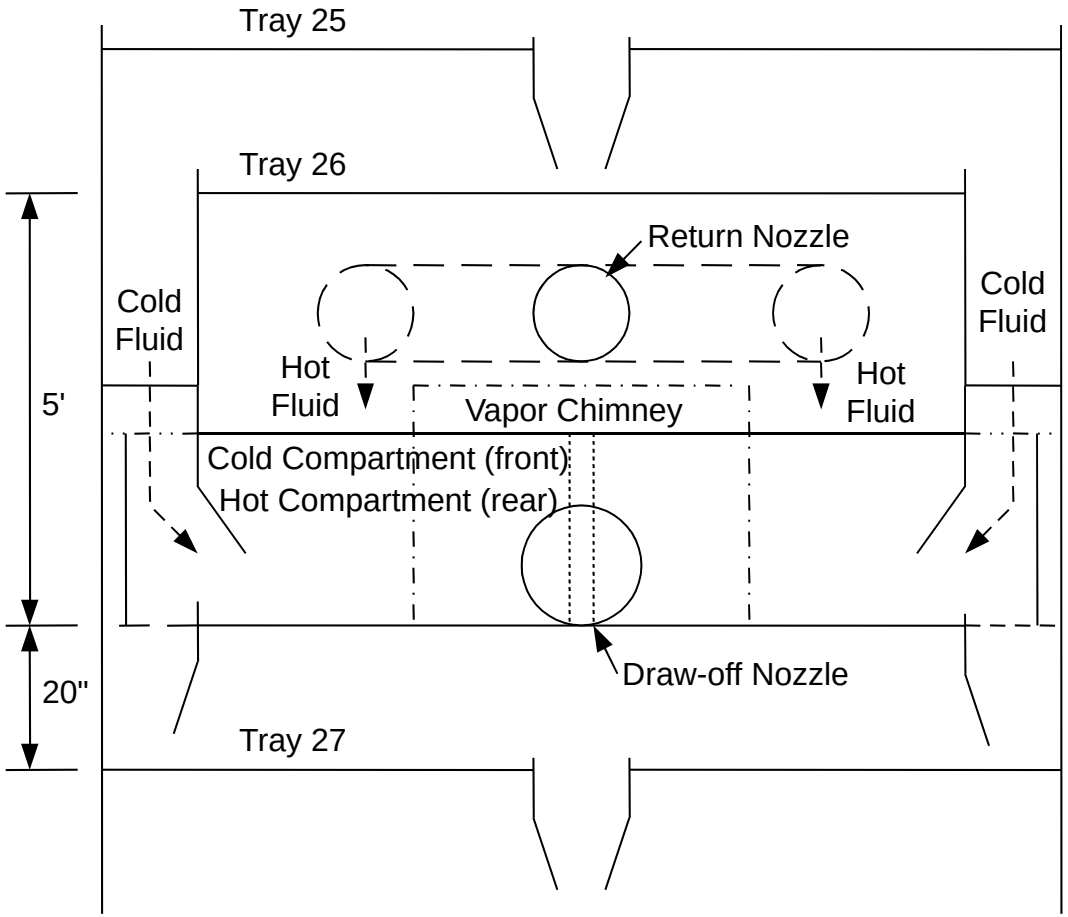
Front View of the Chimney Tray



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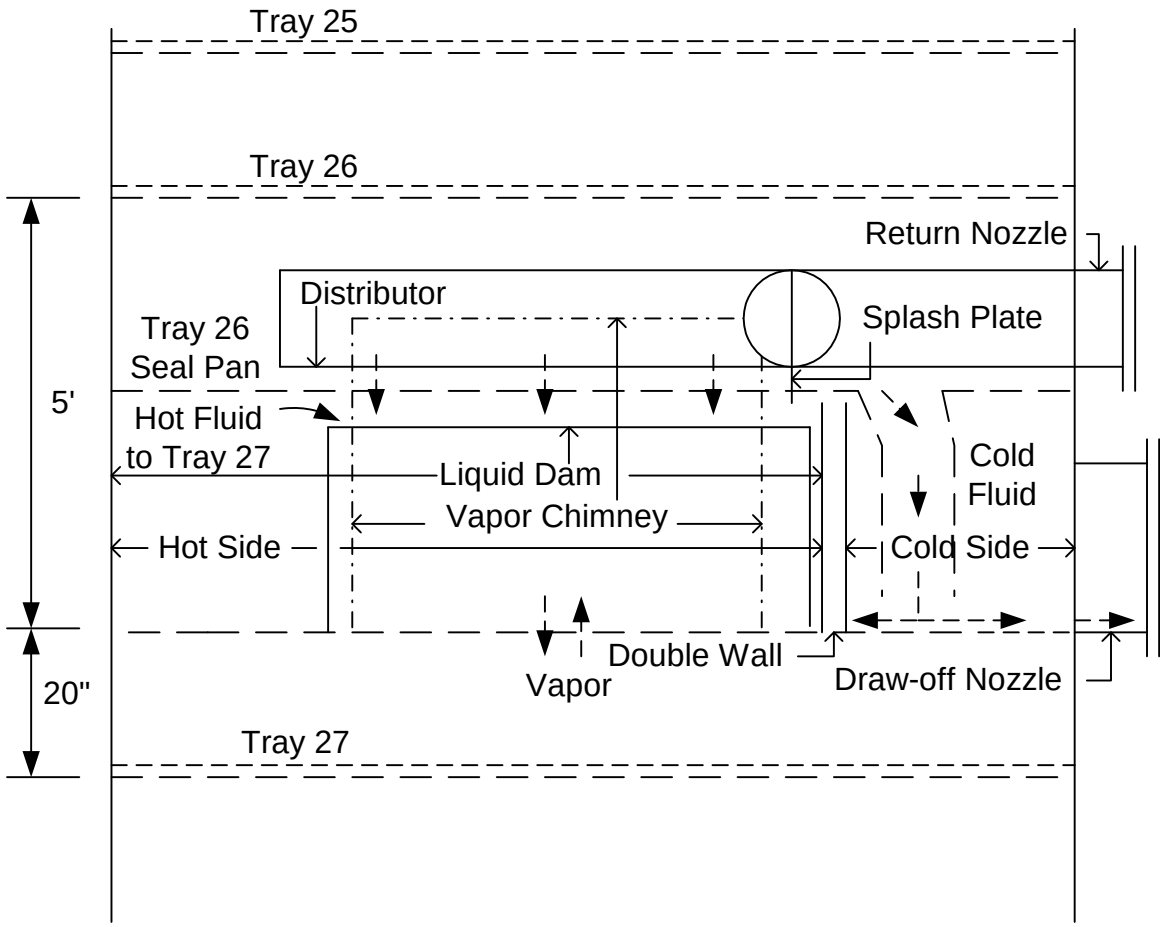
Side View of the Chimney Tray



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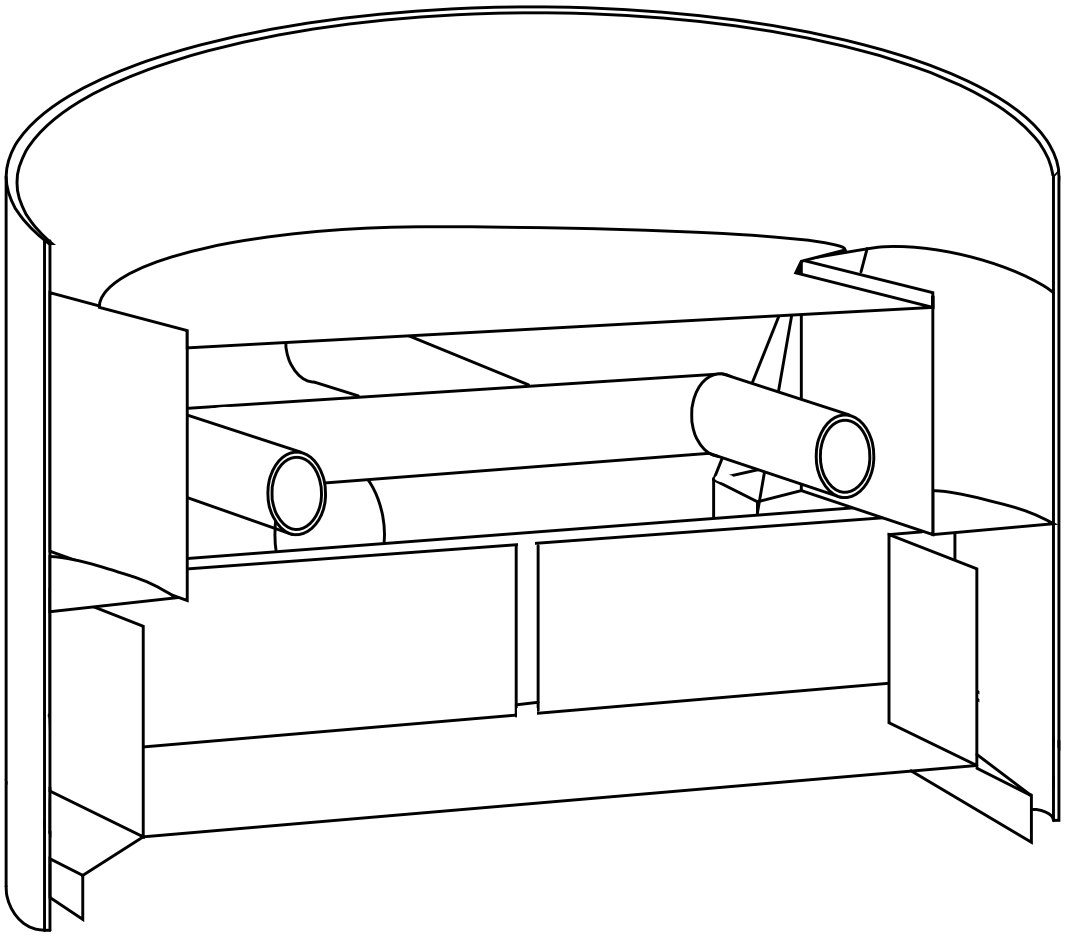
Partial View of the Chimney Tray



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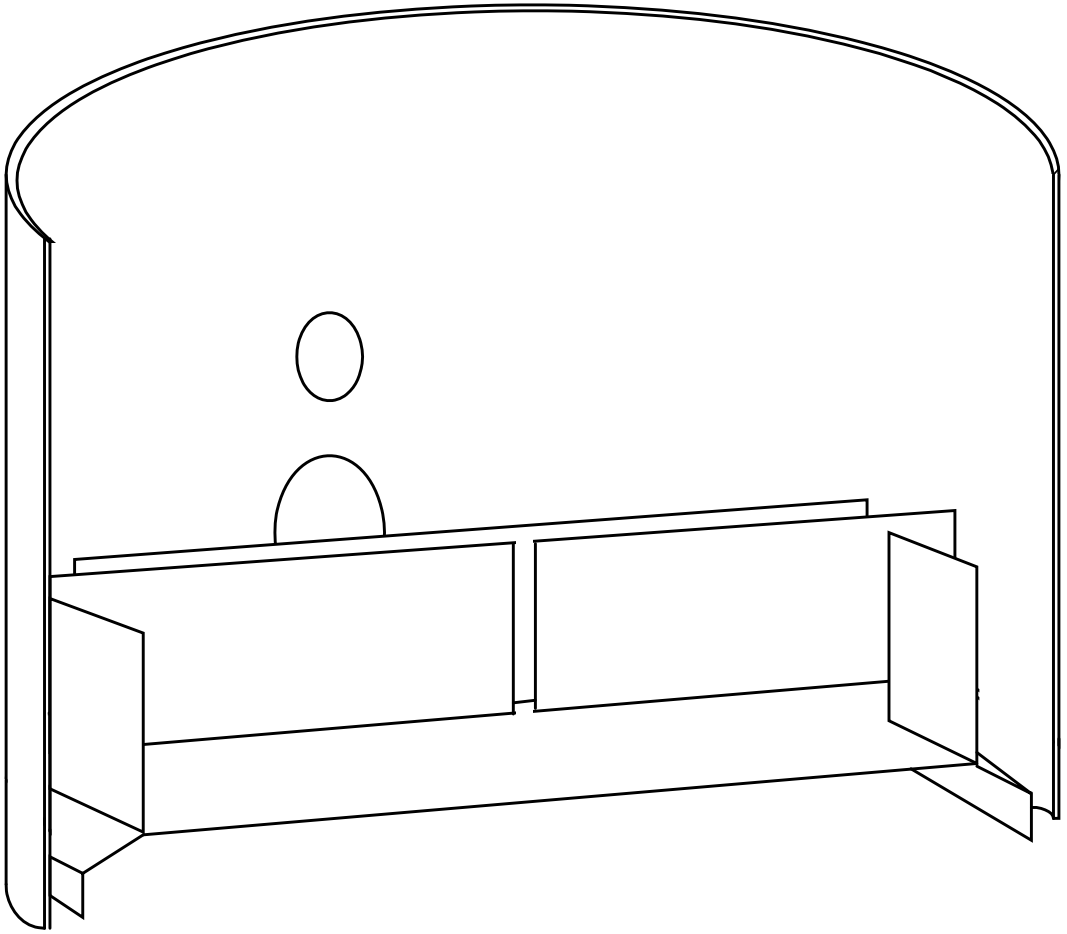
The Double Wall - Heart of The Design



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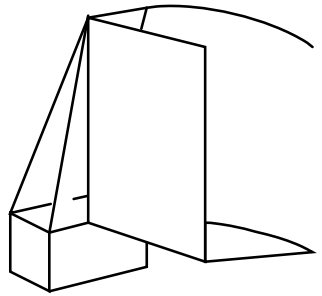
Tray 26 Downcomer Chute



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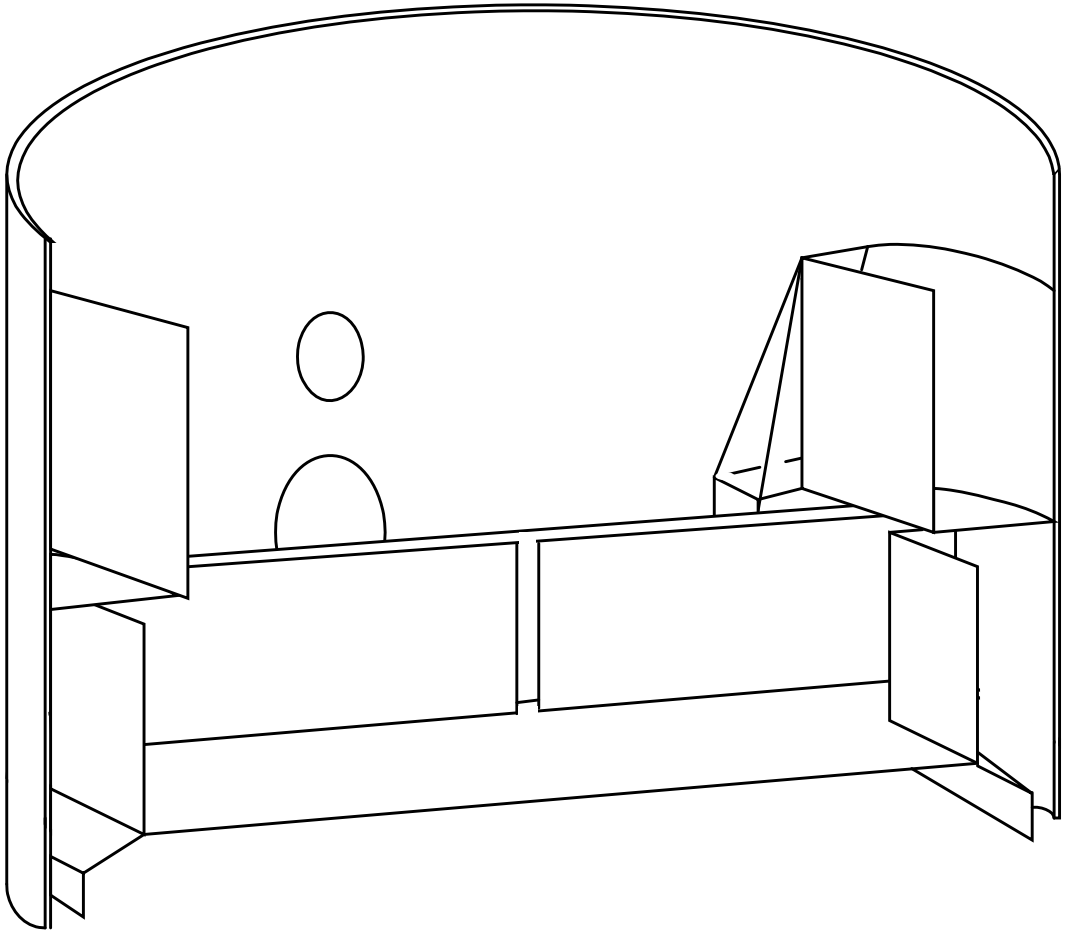
Double Wall & Tray 26 Chute



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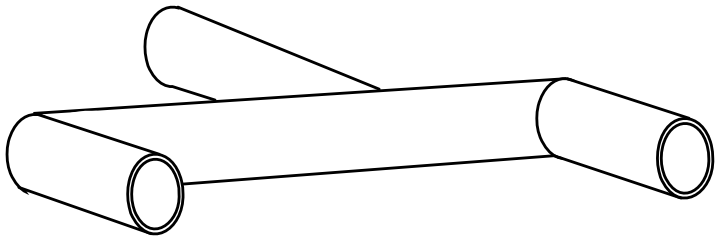
Reboiler Return Distributor



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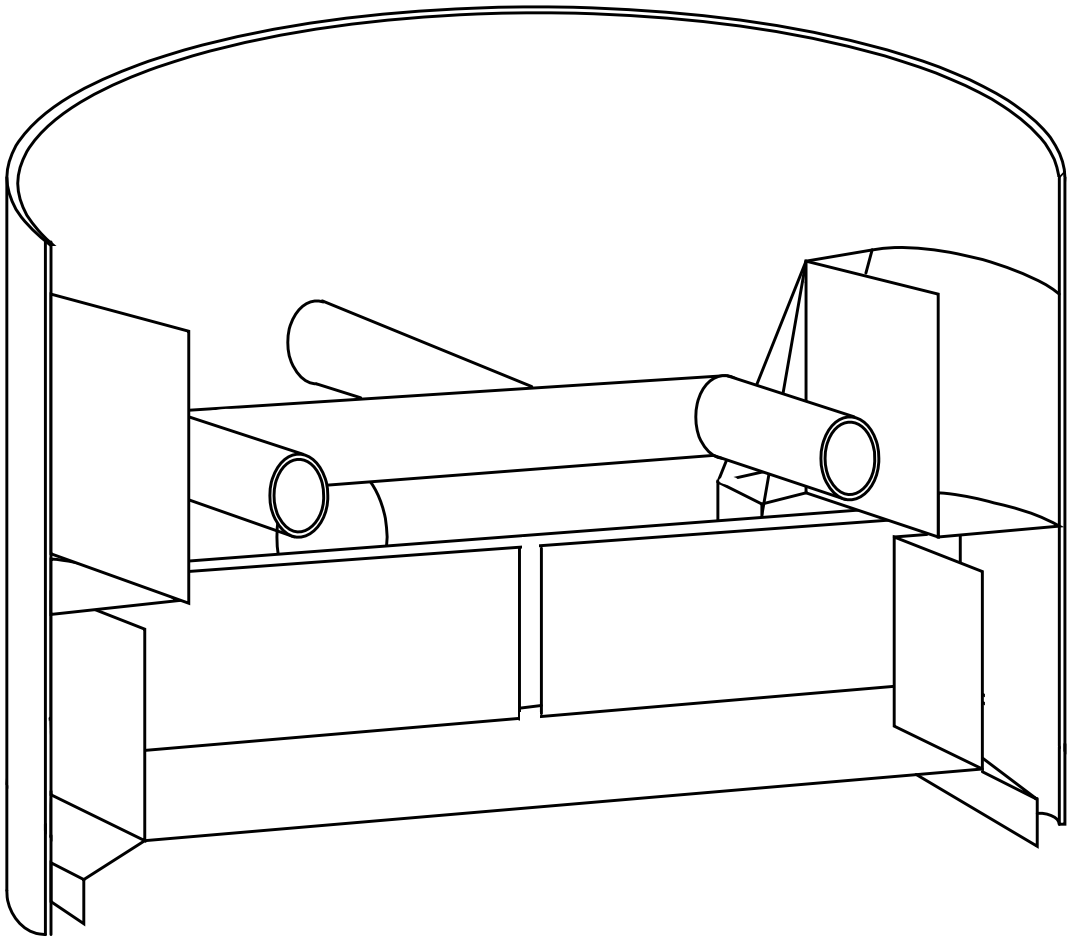
Partial View of the Chimney Tray



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Tray 26 Deck

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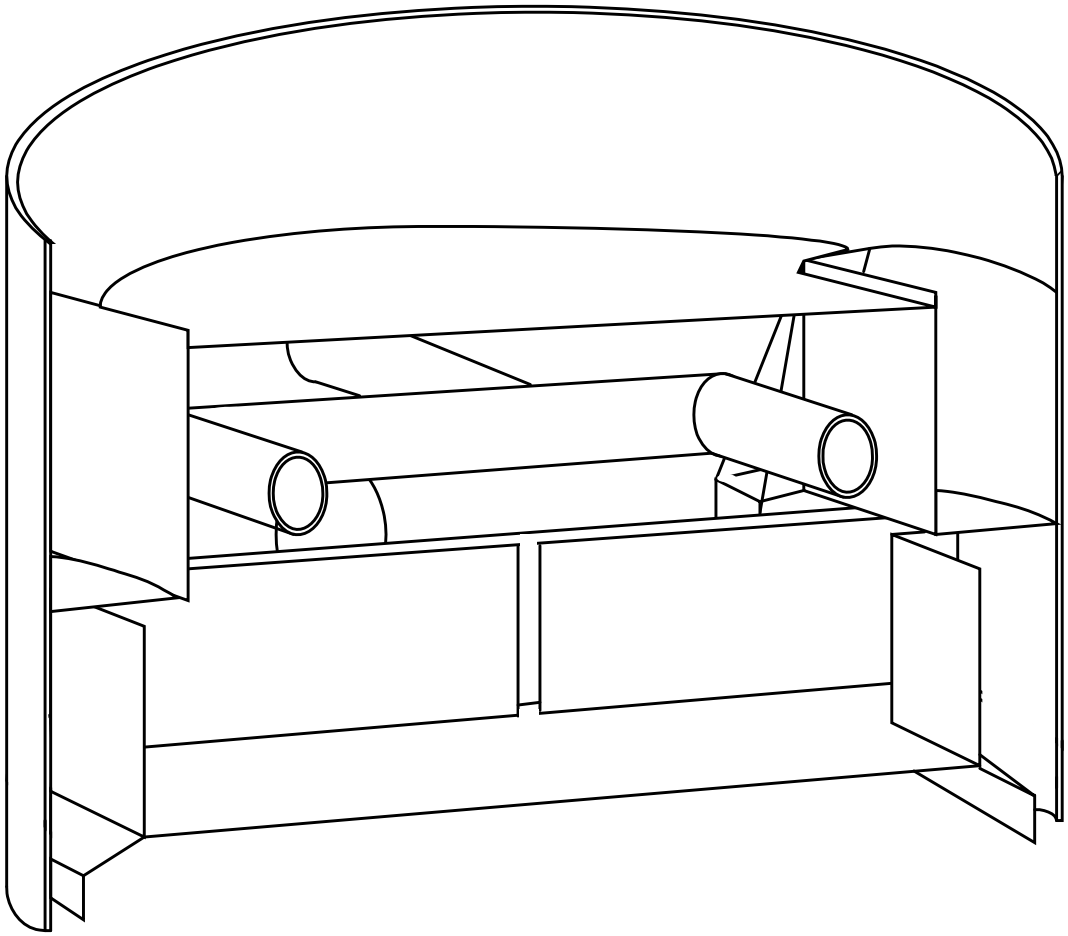
Partial View of the Chimney Tray



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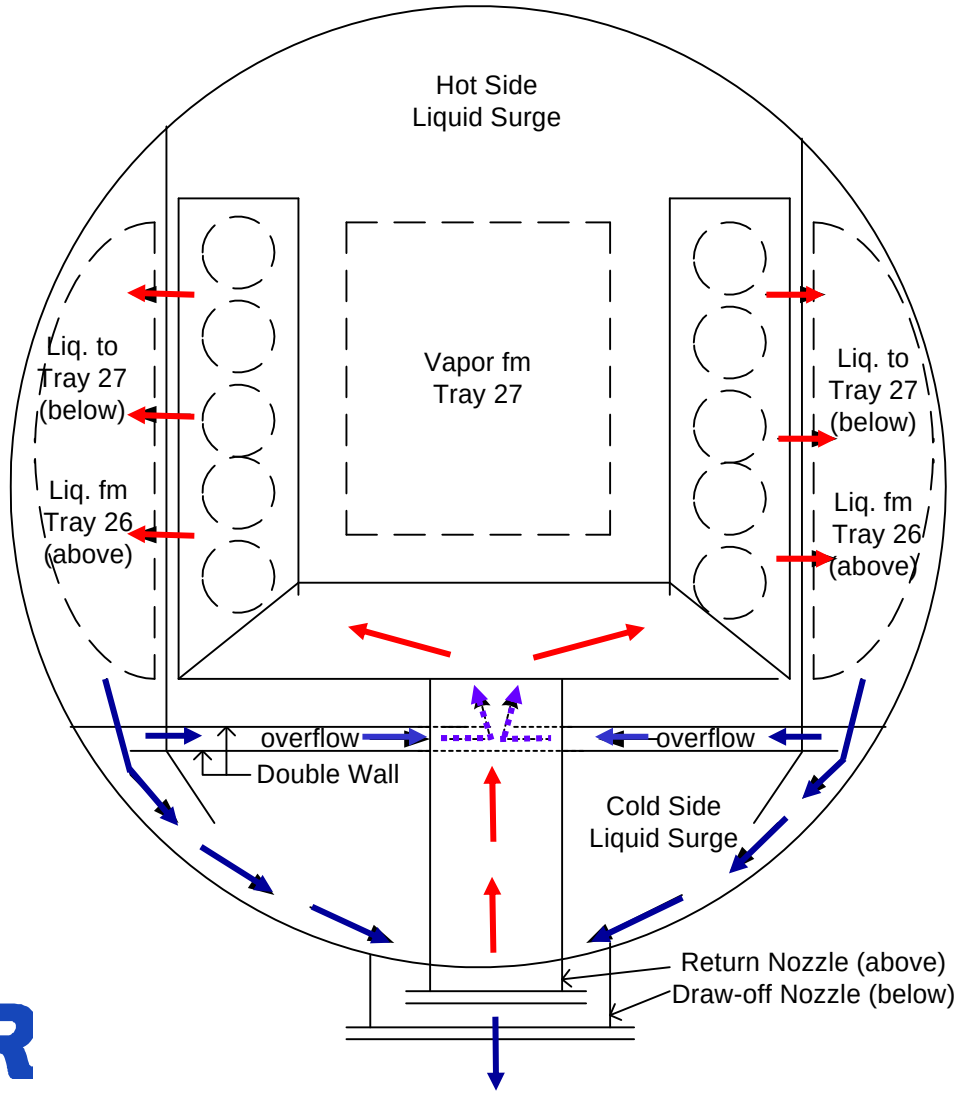
Normal Flow Path



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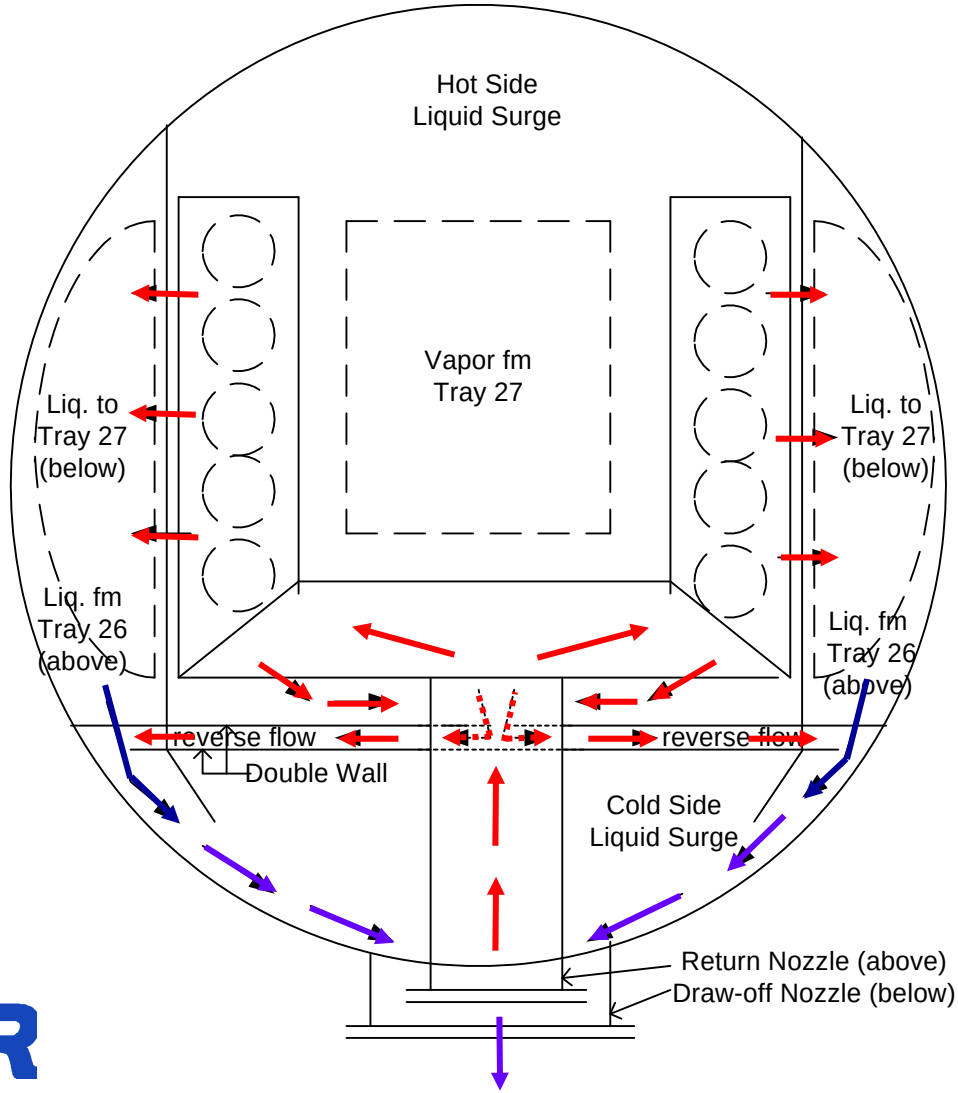
Reverse Flow Path



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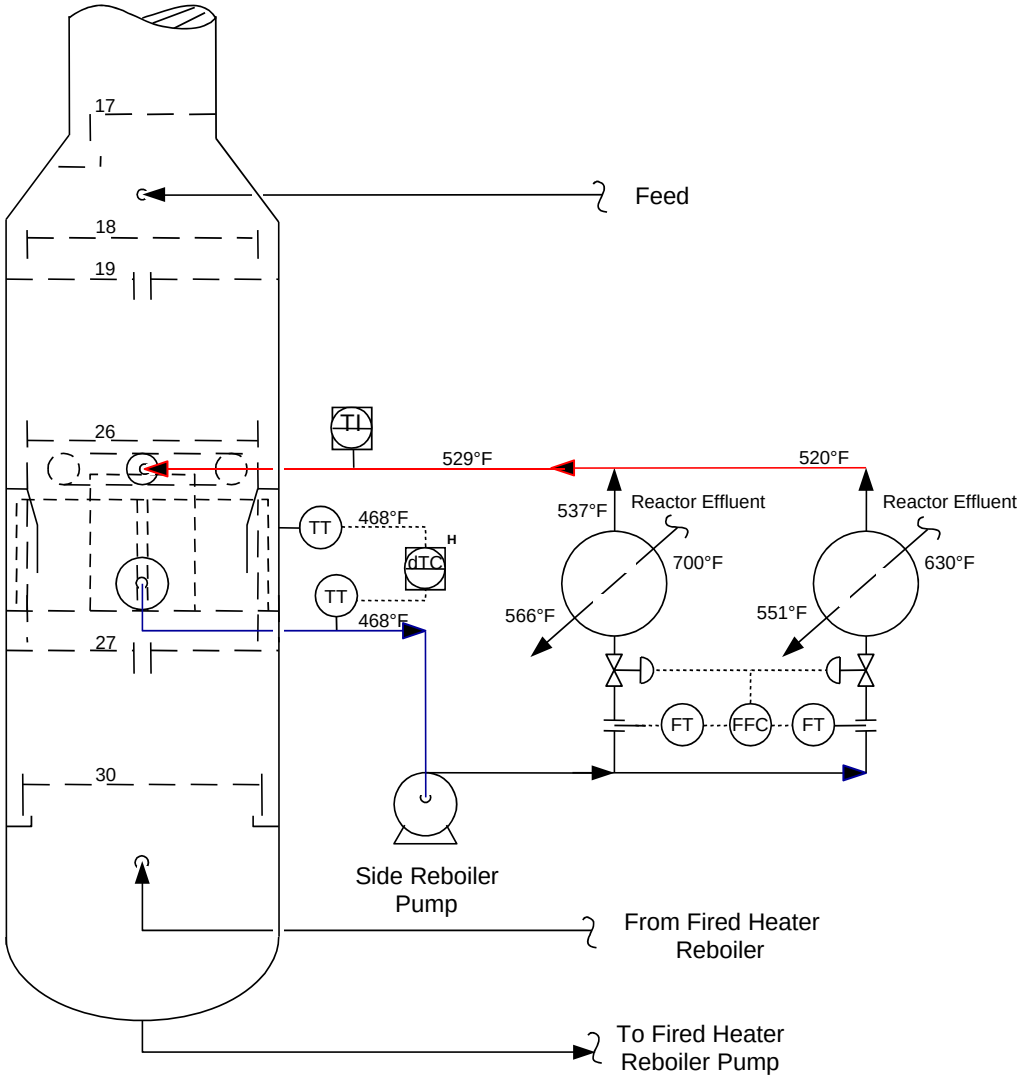
Side Draw and Return Flow Schematic



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Operating Results

- Hot fluid reserves flow to the cold compartment during initial startup as anticipated
- Draw rate increases to 30,000 BPD with a peak rate of 35,000 BPD
- The system has been operating successfully since initial startup

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Conclusion: Benefits of the Double Wall

- Maintain the coldest possible temperature to the side reboiler
- Maximize the side reboiler LMTD
- Minimize the column space loss, i.e., 2 tray loss (or less) for the chimney tray
- Indicate or control the flow direction of the cold or the hot fluid with temperature sensors
- ***Isolate and insulate*** the cold compartment with excess cold fluid flowing through the ***double wall***

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Acknowledgement

Comments/Questions ?

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