Vermont Yankee Cooling Tower Update

October 14, 2008

■ ML083380490

Agenda

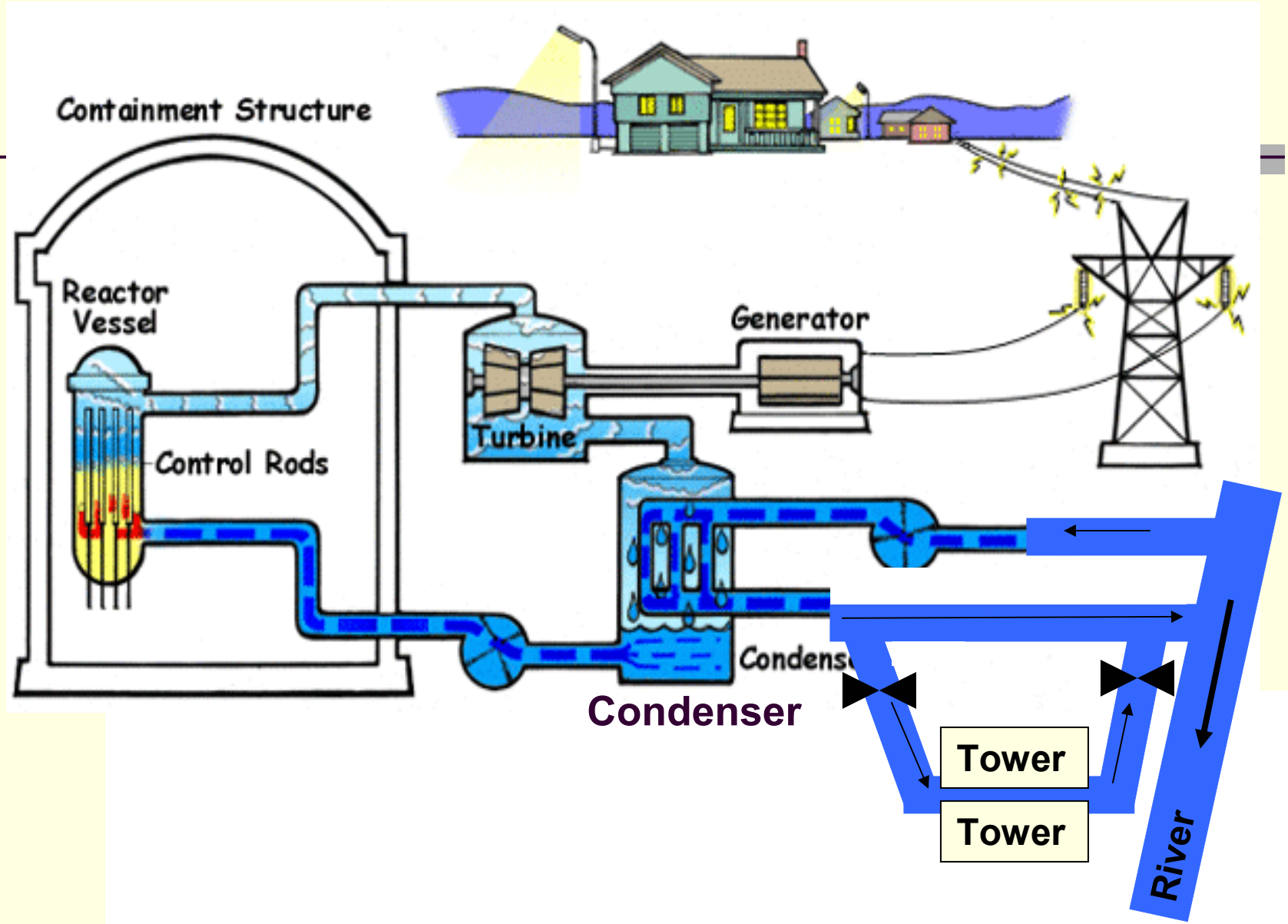
- Introductions
- Basic Plant Overview
- Cooling Tower Overview
  - Normal Cooling Function
  - Safety Function
- Cooling Tower Events
  - Three Events
    - August 2007
    - July 2008
    - September 2008
  - Event Causes and Corrective Actions
  - Event Summary
- Long Range Planning

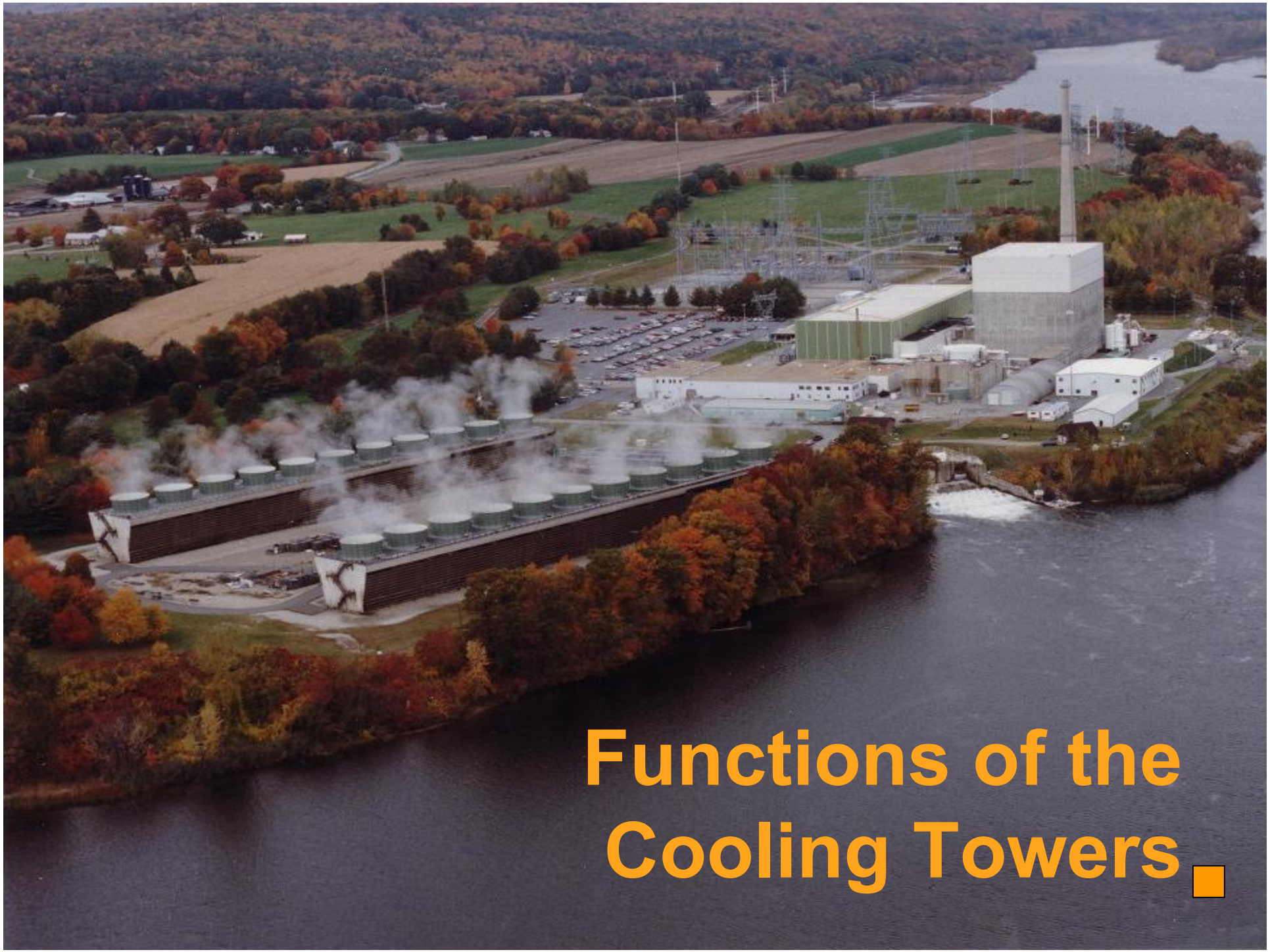
Introductions

Introductions

- Ted Sullivan, Entergy Site Vice President
- Chris Wamser, Gen. Manager Plant Operations
- John Dreyfuss, Director, Nuclear Safety Assurance
- Norm Rademacher, Director of Engineering

Basic Plant Operation


Containment Structure
Reactor Vessel
Control Rods
Turbine
Generator
Condenser
Tower
Tower
River



Functions of the Cooling Towers

Cooling Tower Functions

- Normal Cooling Function
- Safety Function

Cooling Function

Cooling Function

- Purpose
- Modes of Operation
- Design Overview
- Design Features

Cooling Function - Purpose

- Cool River Water prior to return to Connecticut River
- Maintain Environmental Conditions for river
- NPDES Thermal Discharge Permit

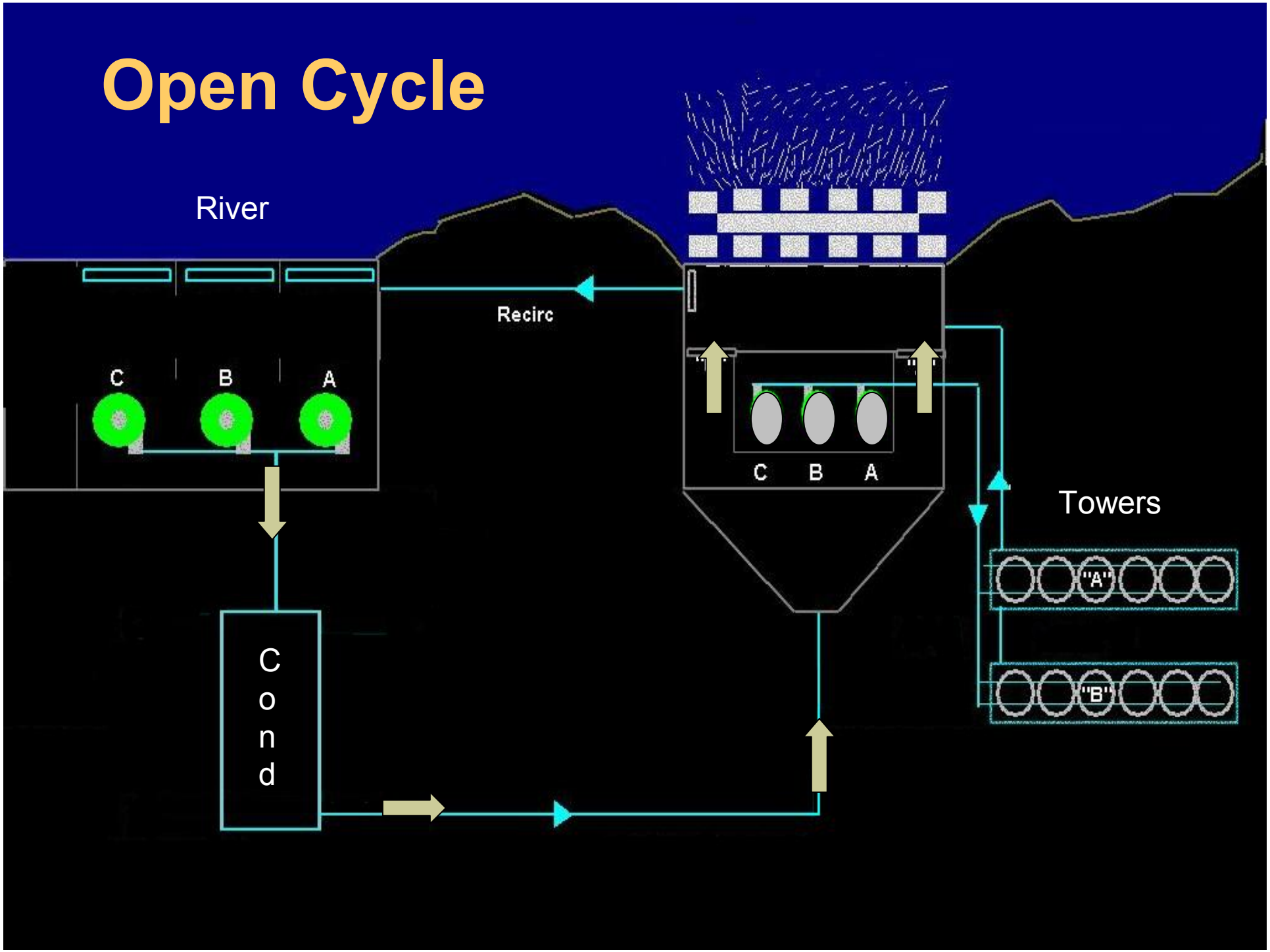
Cooling Water

Modes of Operation

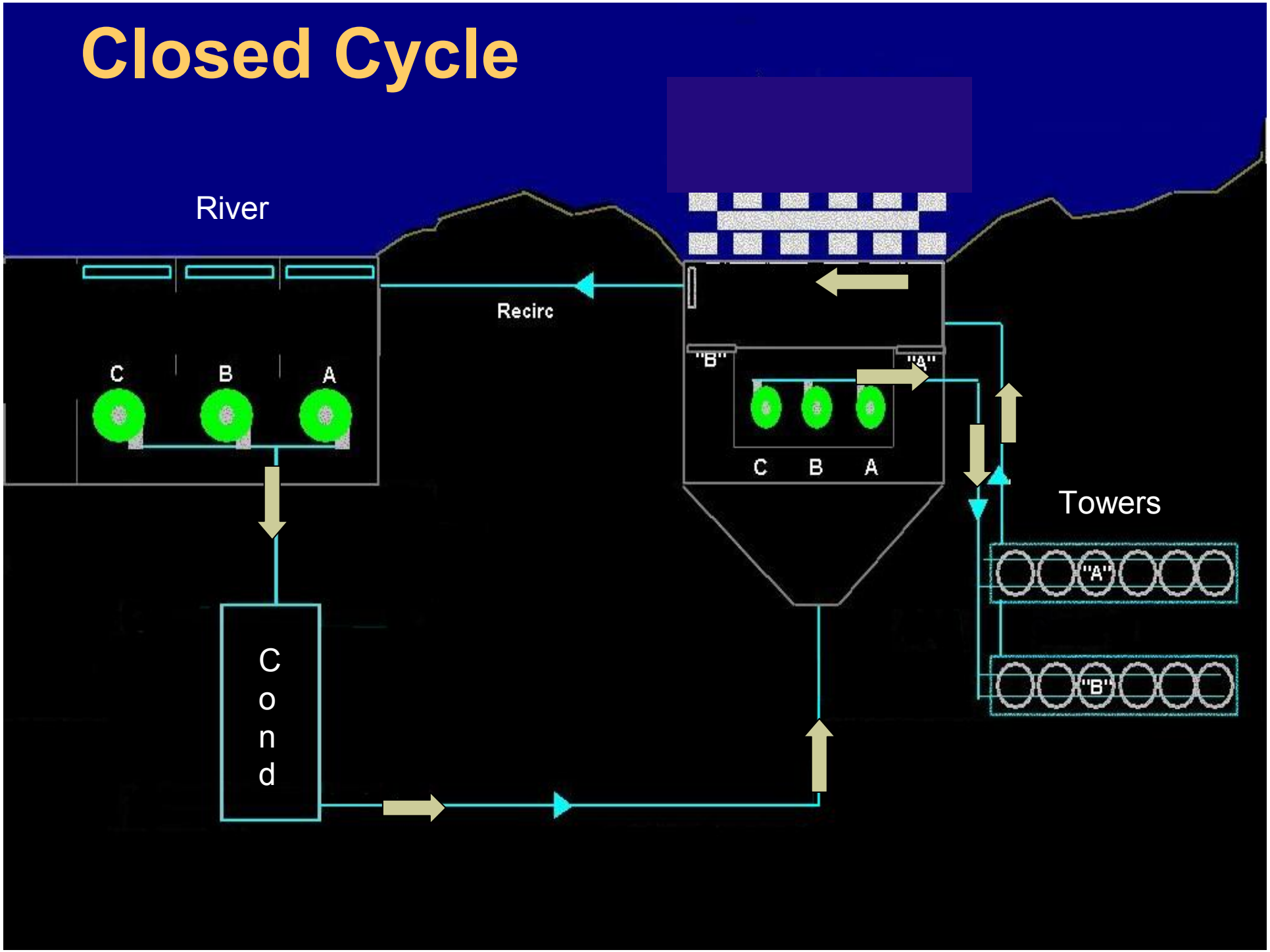
Cooling Water Modes

- Open
- Closed

Open Cycle



Closed Cycle



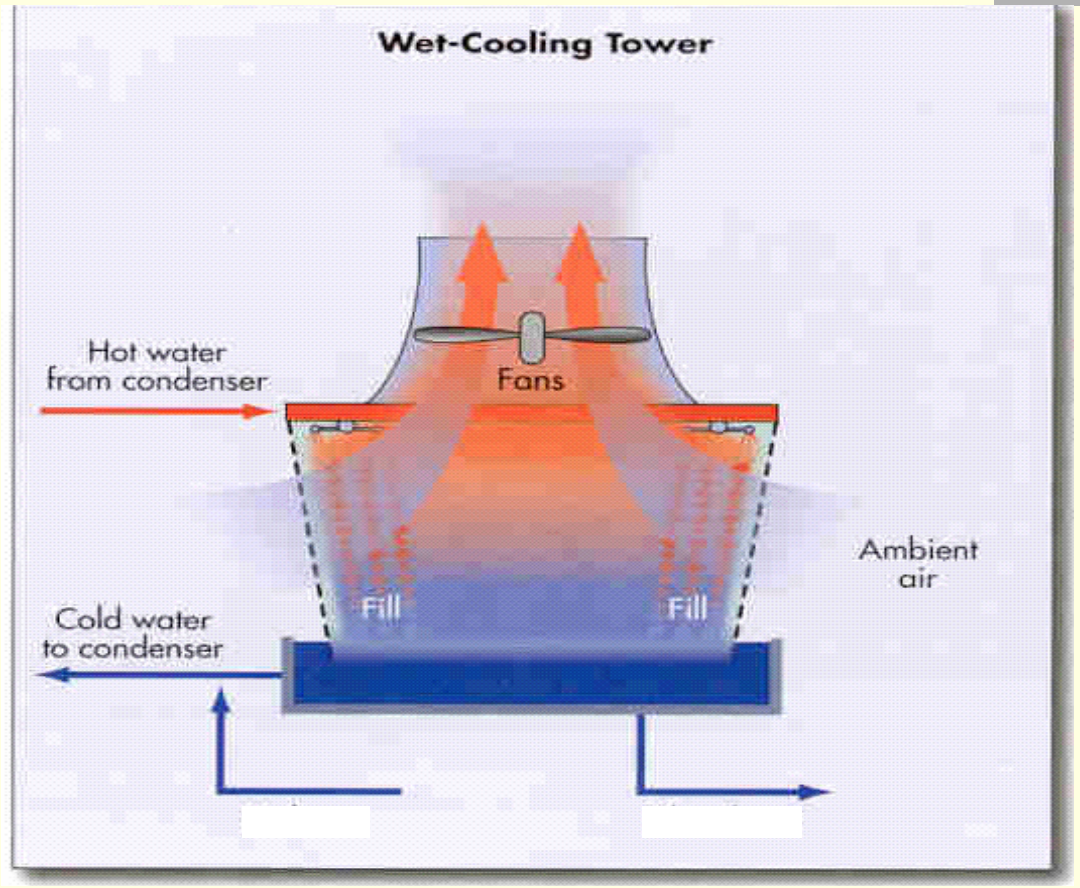
Modes of Operation - Summary

- Cooling Tower operation is dictated by River Conditions

  - Season
  - River Flow
  - River Temperature

Cooling Tower Design

Cooling Tower Design



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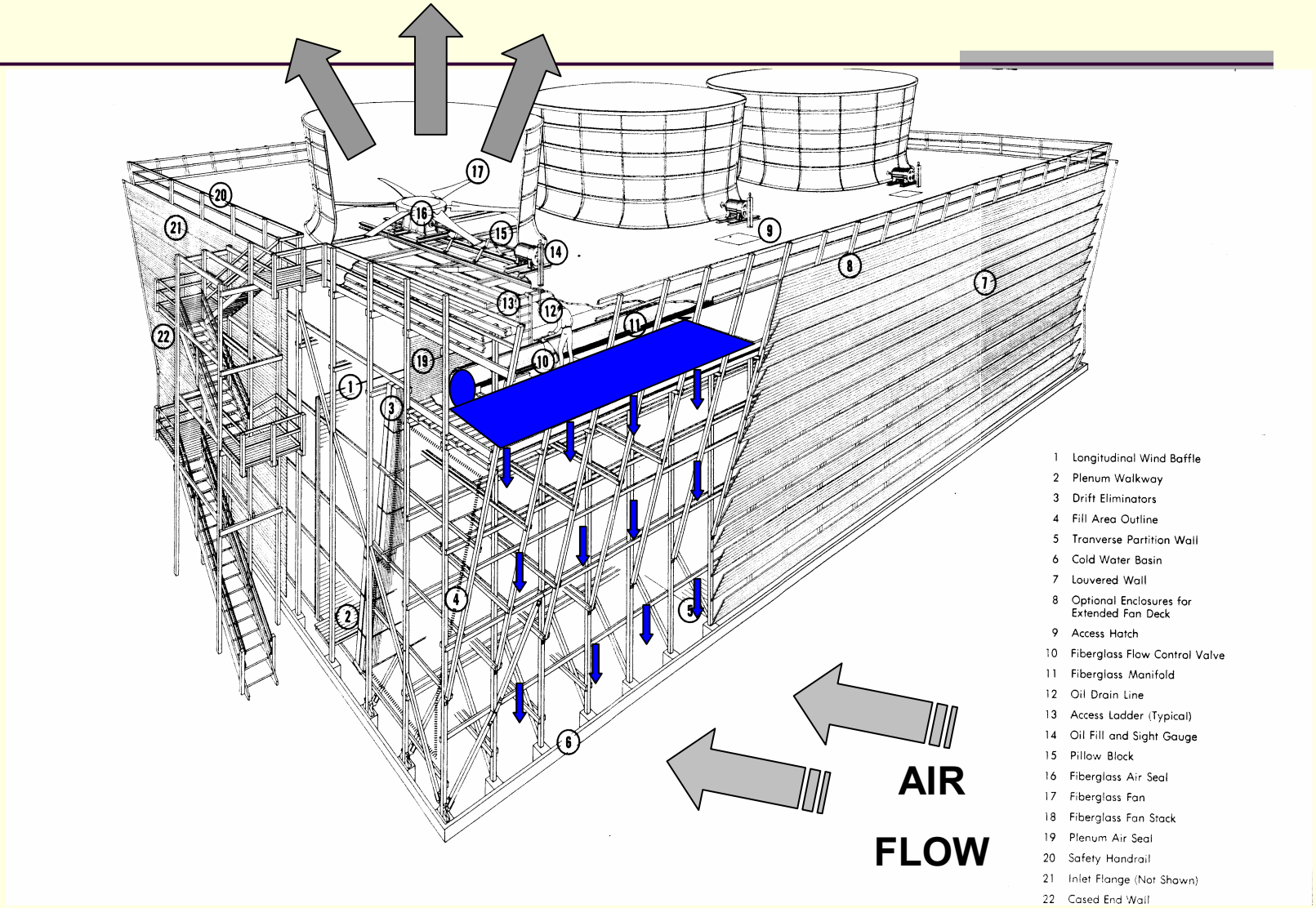
WATER VAPOR
HEAT REJECTED



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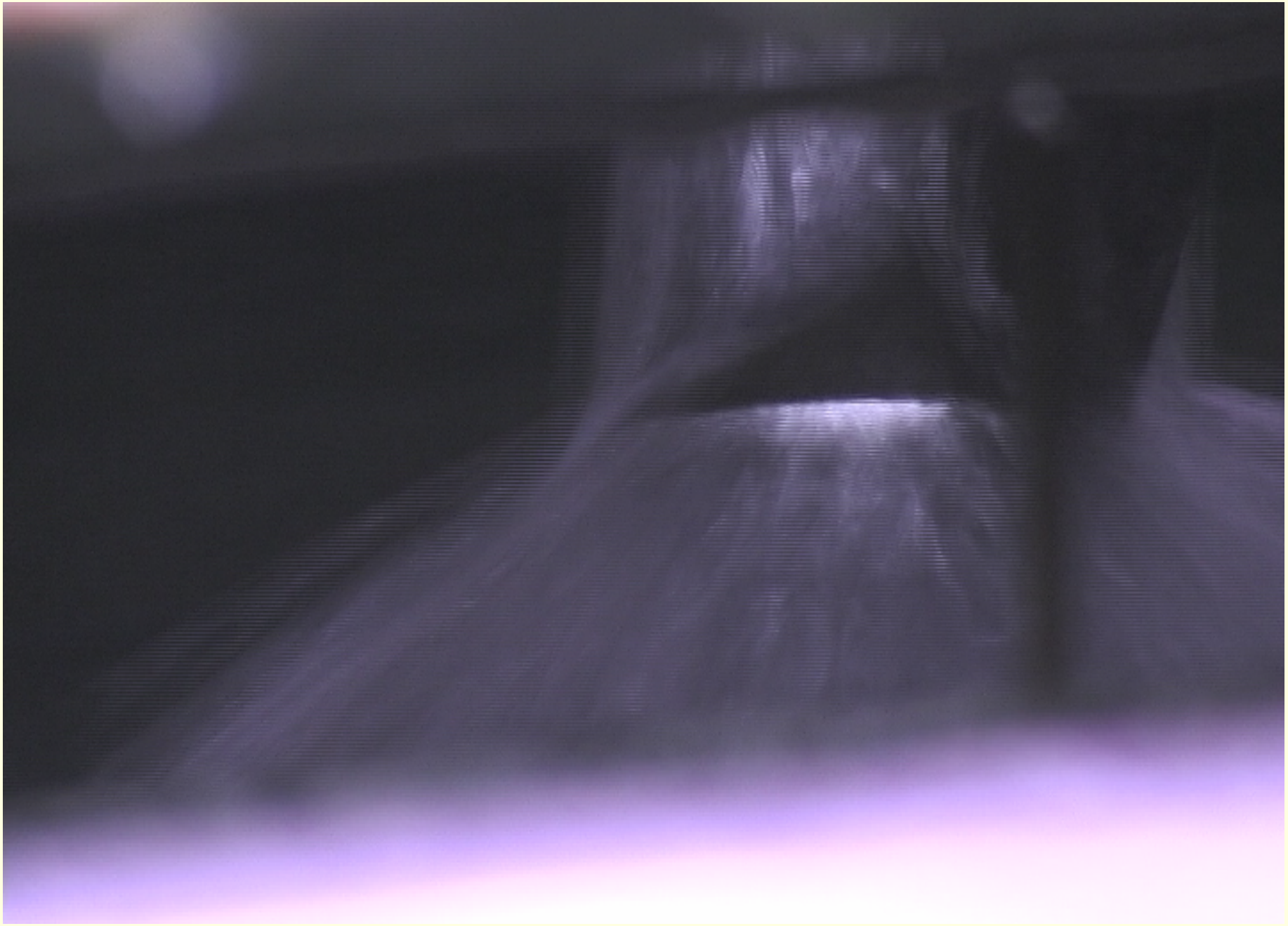

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Cooling Tower Design Features

Design Features

- Two 500’ Long Towers
  - Tower 1 (East)
  - Tower 2 (West)
- 11 Cells per Tower
- Each Cell has one fan and motor
- Water distribution system

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Design Features – Water Distribution

- Two Distribution Headers per Tower
- 90,000 GPM each
- Multiple Sections, “Bell and Spigot” Joint Design
- Pipe Size Varies: 60” to 24”
- Water Deck / Distribution Valves
- Fill Material

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Back to pg. 28

Design Features – Structural Support

- Loads:
  - Water (primary)
  - Fan/motor (secondary)
- Saddle Configuration – HOLDS UP PIPE
- Columns – support water and fans
- Joints

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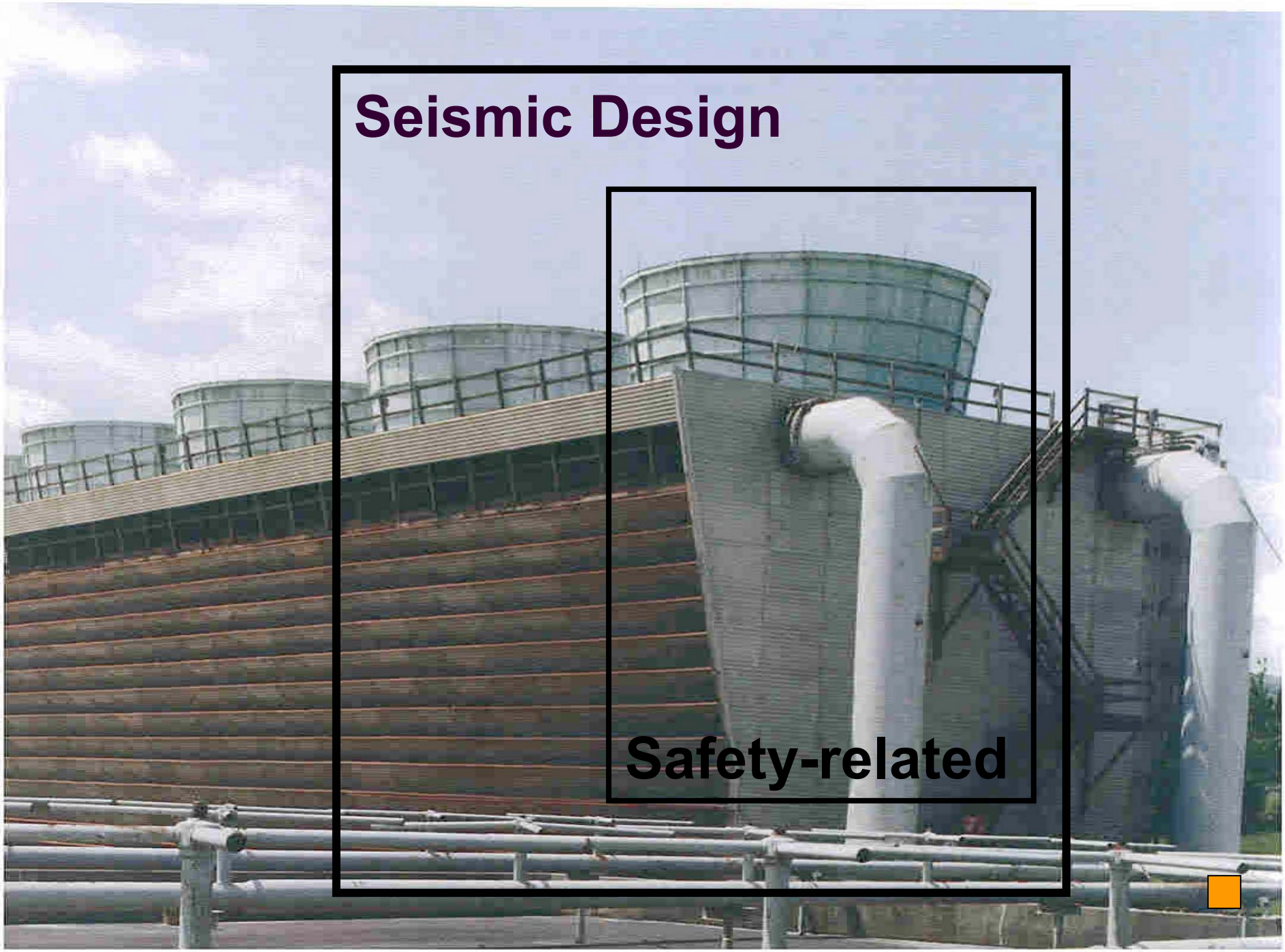
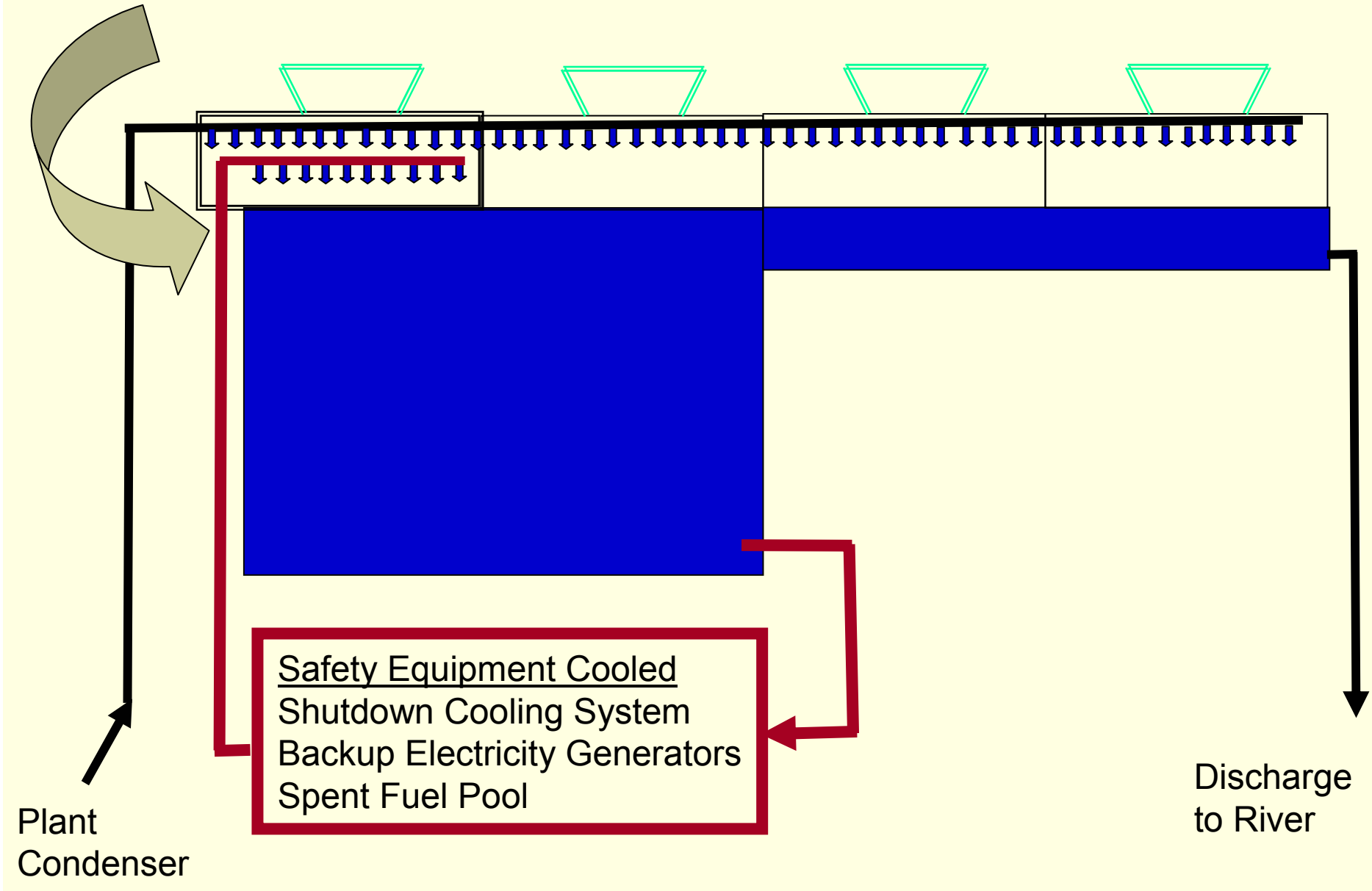
Safety Function

Safety Function

- Safety Related Cell 2-1
- Seismic Qualification Cell 2-2
- Alternate Cooling – Loss of Intake
- Independent from normal Cooling Function


Seismic Design
Safety-related

Safety Related Cell CT2-1 Provides Backup Source of Cooling



Independent Safety Piping

Cooling Tower Events

Cooling Tower Events

- August 2007: Cell 2-4 Failure
- July 2008: Support Saddle Failures
- September 2008: Distribution Header Leak

Cell 2-4 Failure
August 2007

Cell 2-4 Failure

- Causes of Event
- Corrective Actions

Cell 2-4 Failure – Cause of Event

- Two support columns failed
- Failure of B Columns caused Distribution Header to sag
  - Loosened slip joints and caused large leaks
- Additional water increased weight on remaining support columns
- Other Support columns overloaded and failed
- Resulted in a partial collapse

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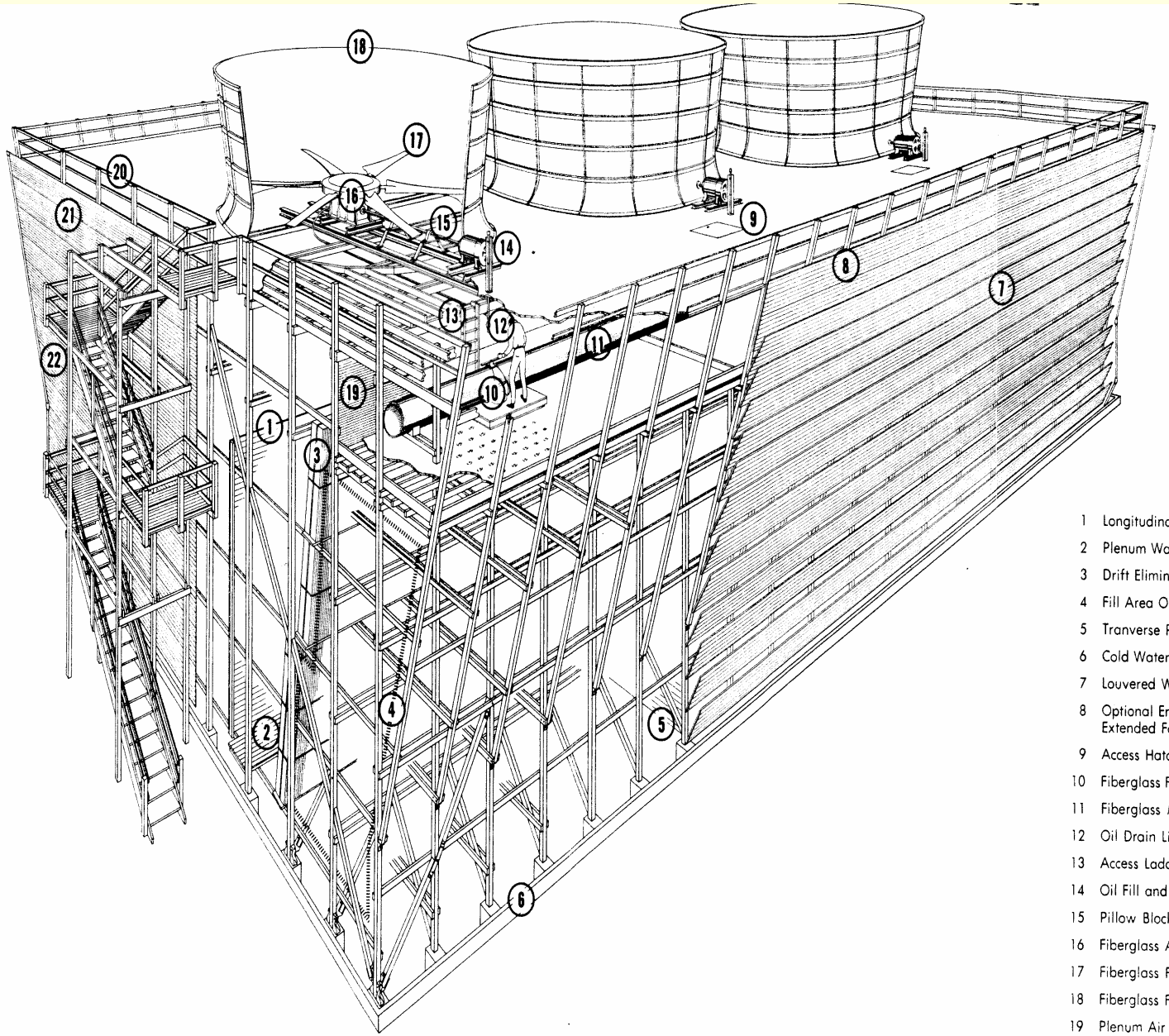

1 Longitudinal Wind Baffle
2 Plenum Walkway
3 Drift Eliminators
4 Fill Area Outline
5 Tranverse Partition Wall
6 Cold Water Basin
7 Louvered Wall
8 Optional Enclosures for Extended Fan Deck
9 Access Hatch
10 Fiberglass Flow Control Valve
11 Fiberglass Manifold
12 Oil Drain Line
13 Access Ladder (Typical)
14 Oil Fill and Sight Gauge
15 Pillow Block
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20 Safety Handrail
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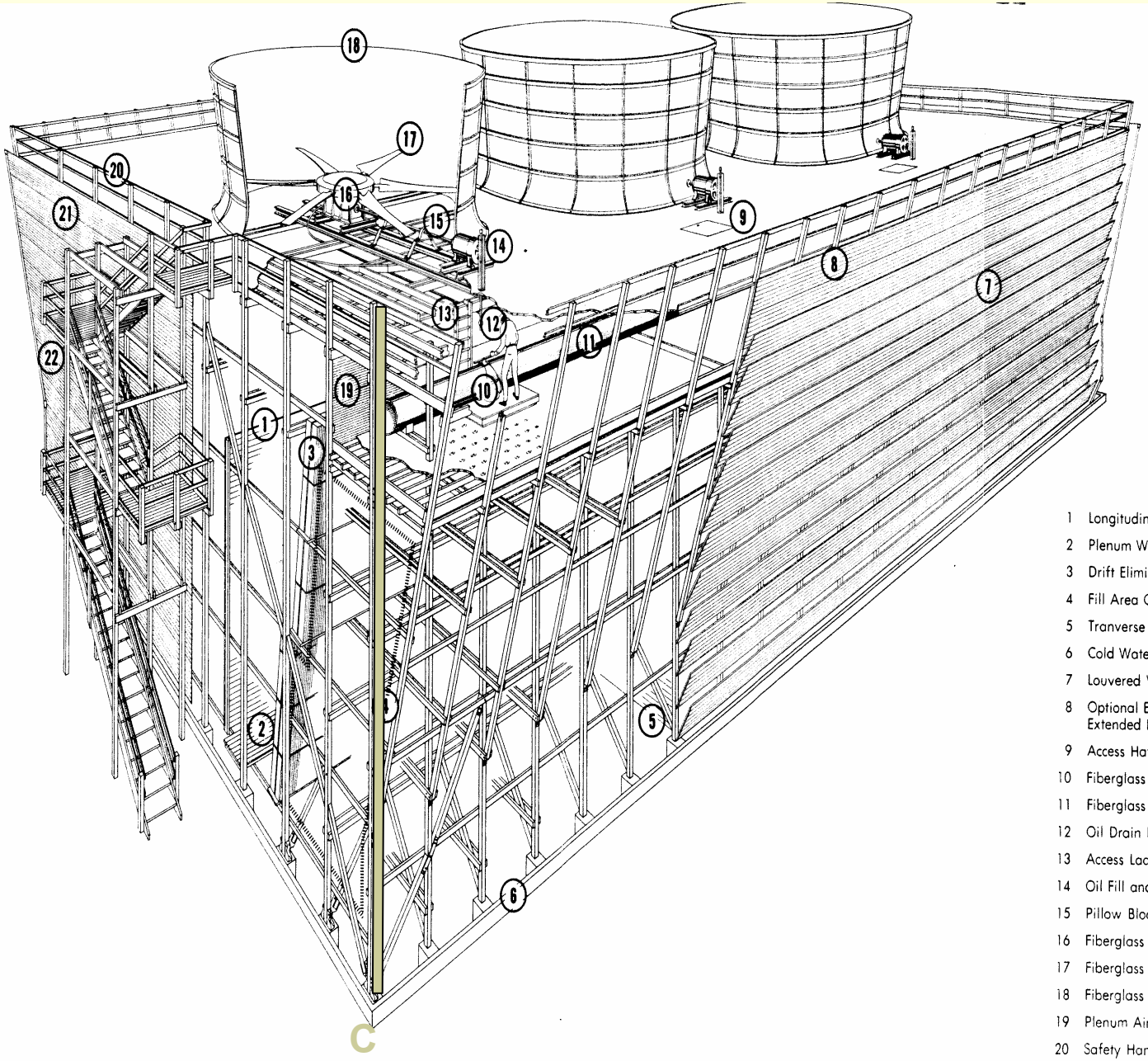
22 Cased End Wall



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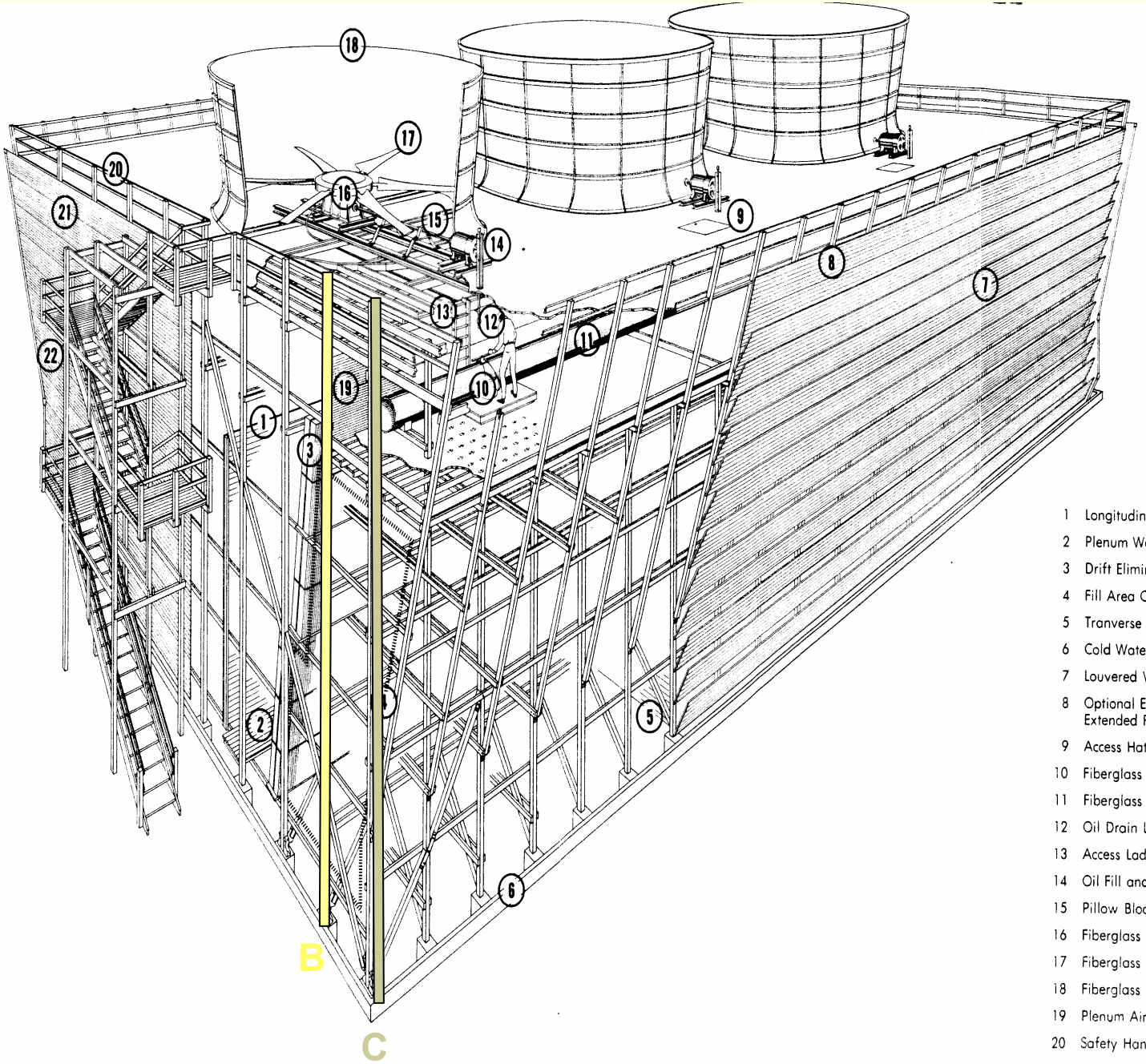

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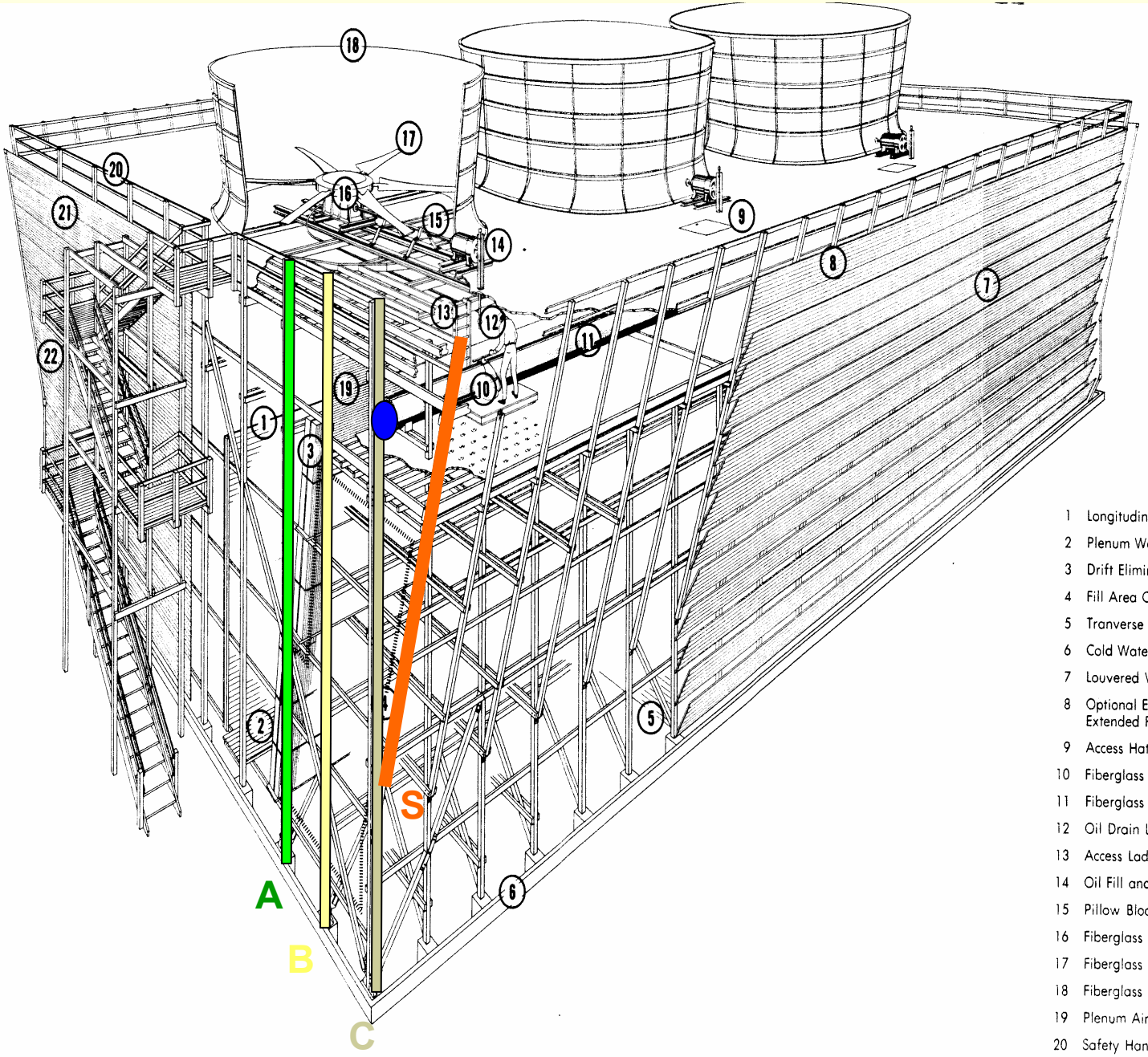

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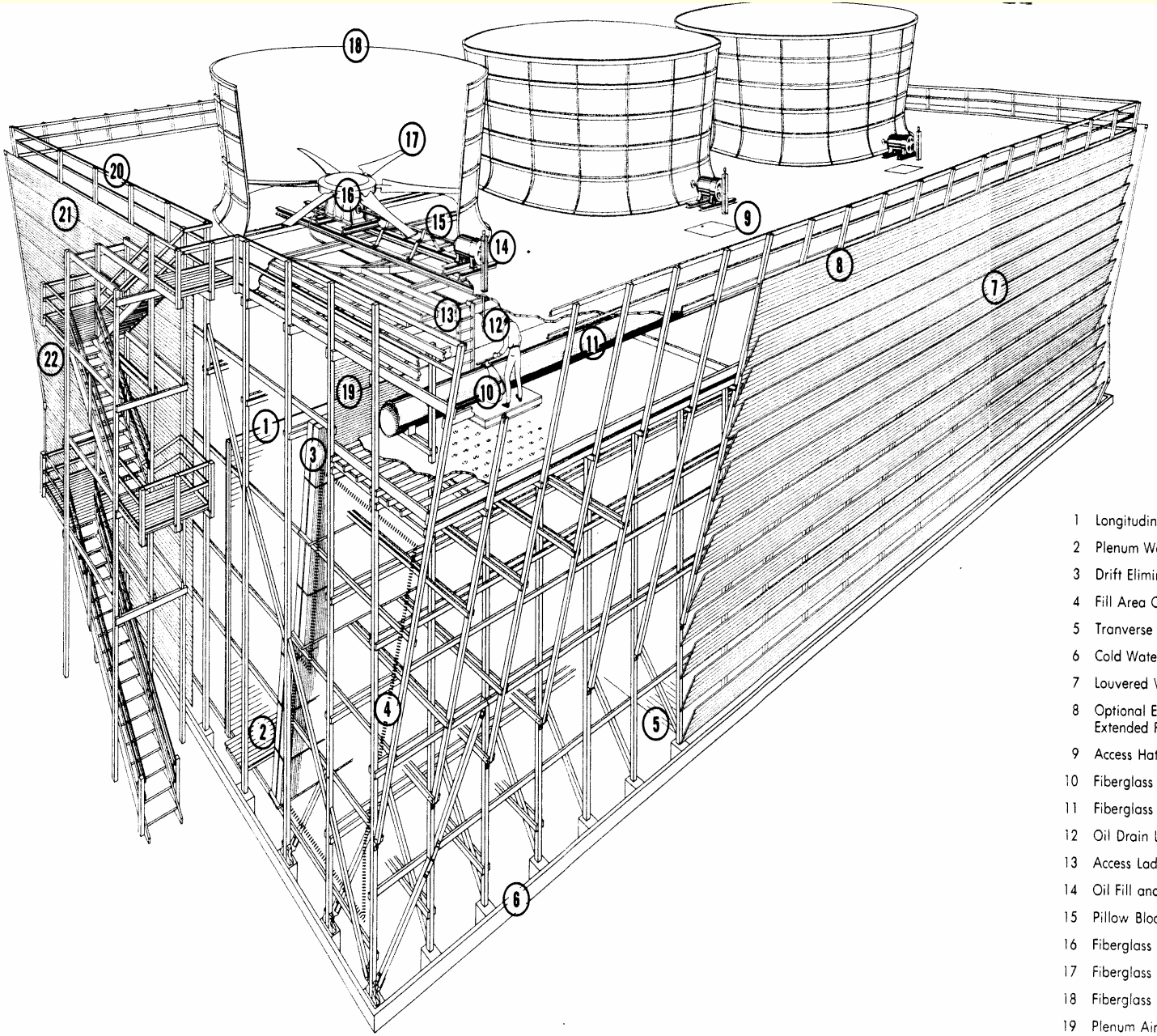

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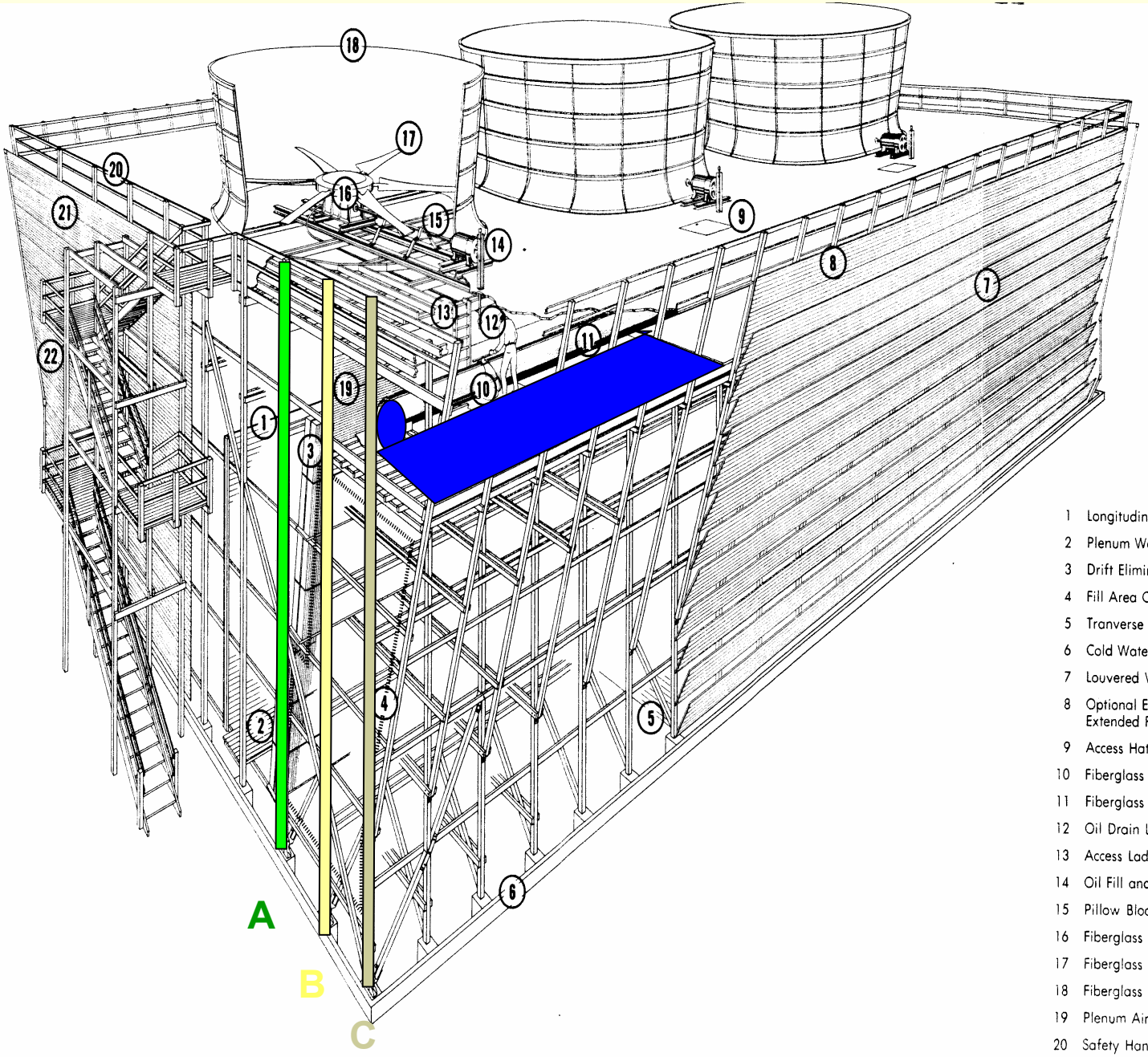

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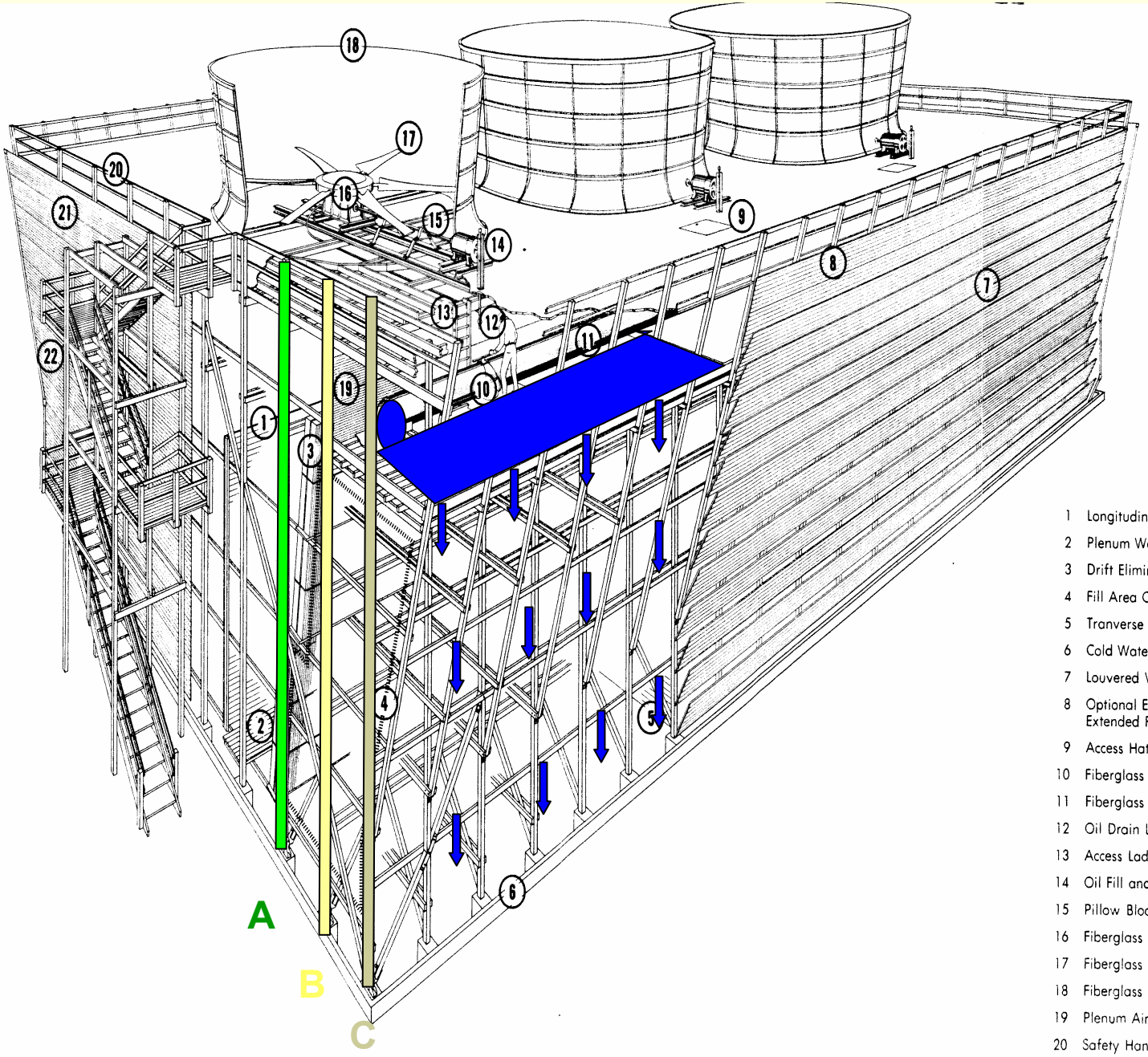

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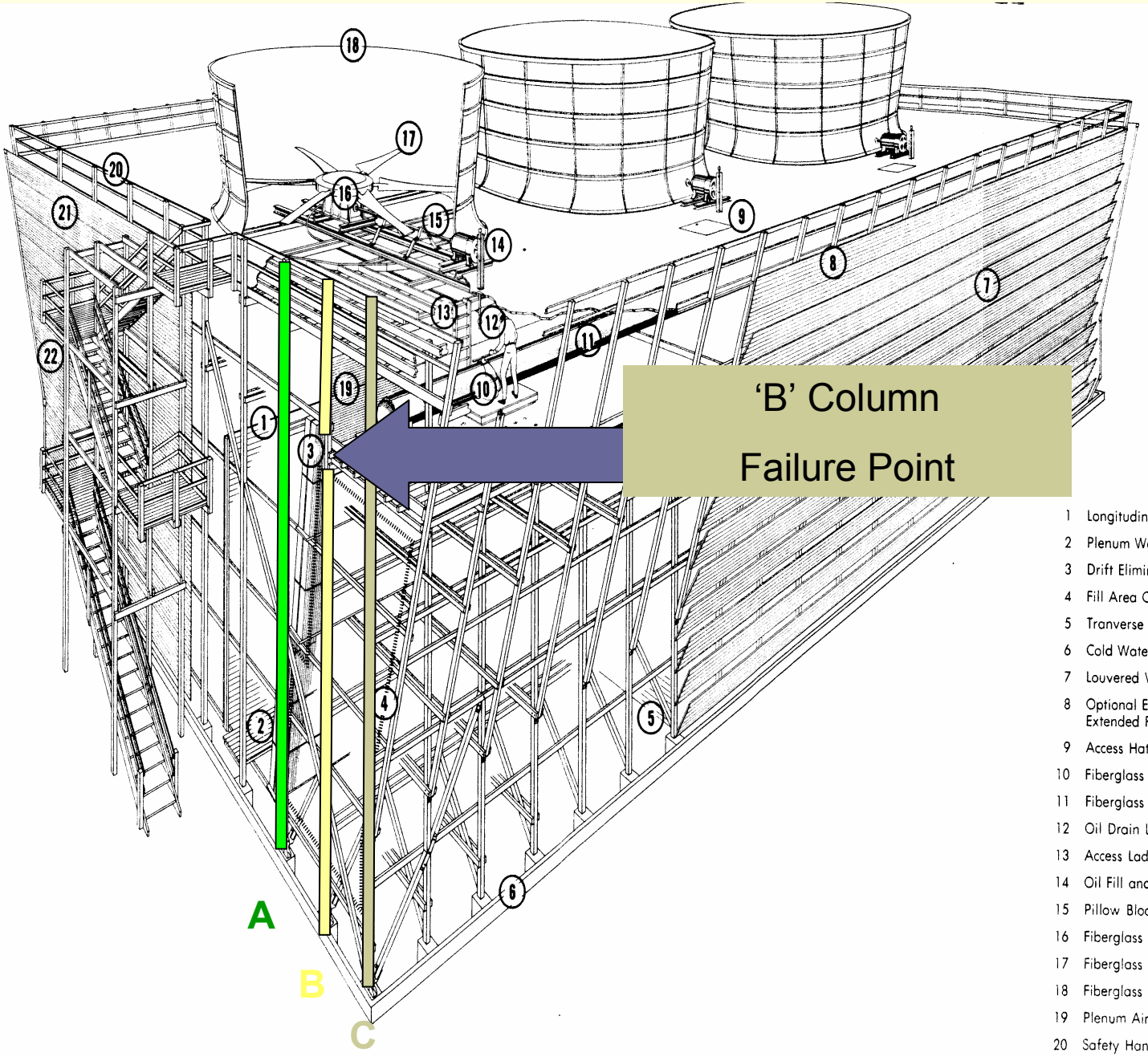

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Cell 2-4 Failure – Causal Investigation

- **Root Cause:**

  Support columns failed due to overload condition

- **Other Causes:**
  - **Inadequate Inspection Methods of Wood Structure**
  - **Inadequate Preventative Maintenance**

- **Contributing Cause: Design of Fill Material**

Cell 2-4 Failure – Corrective Actions

- Rebuilt Cell 2-4
- Completed Extent of Condition Inspections and Repairs
- Fully Revised Inspection Procedures and Acceptance Criteria
- Established 2008 Cooling Tower Project Plan

Cell 2-4 Failure – Corrective Actions

- **Phase 1 of Long Range Plan – Completed May 2008**
  - **1/3 Replacement – (Bay 4)**
  - **New Structural Member Material: Fiberglass Reinforced Plastic (FRP)**
    - **New Fill Material**
    - **Extent of Condition Repairs**
- **Used External/Fleet Technical Expertise**
- **Long Range Plan**

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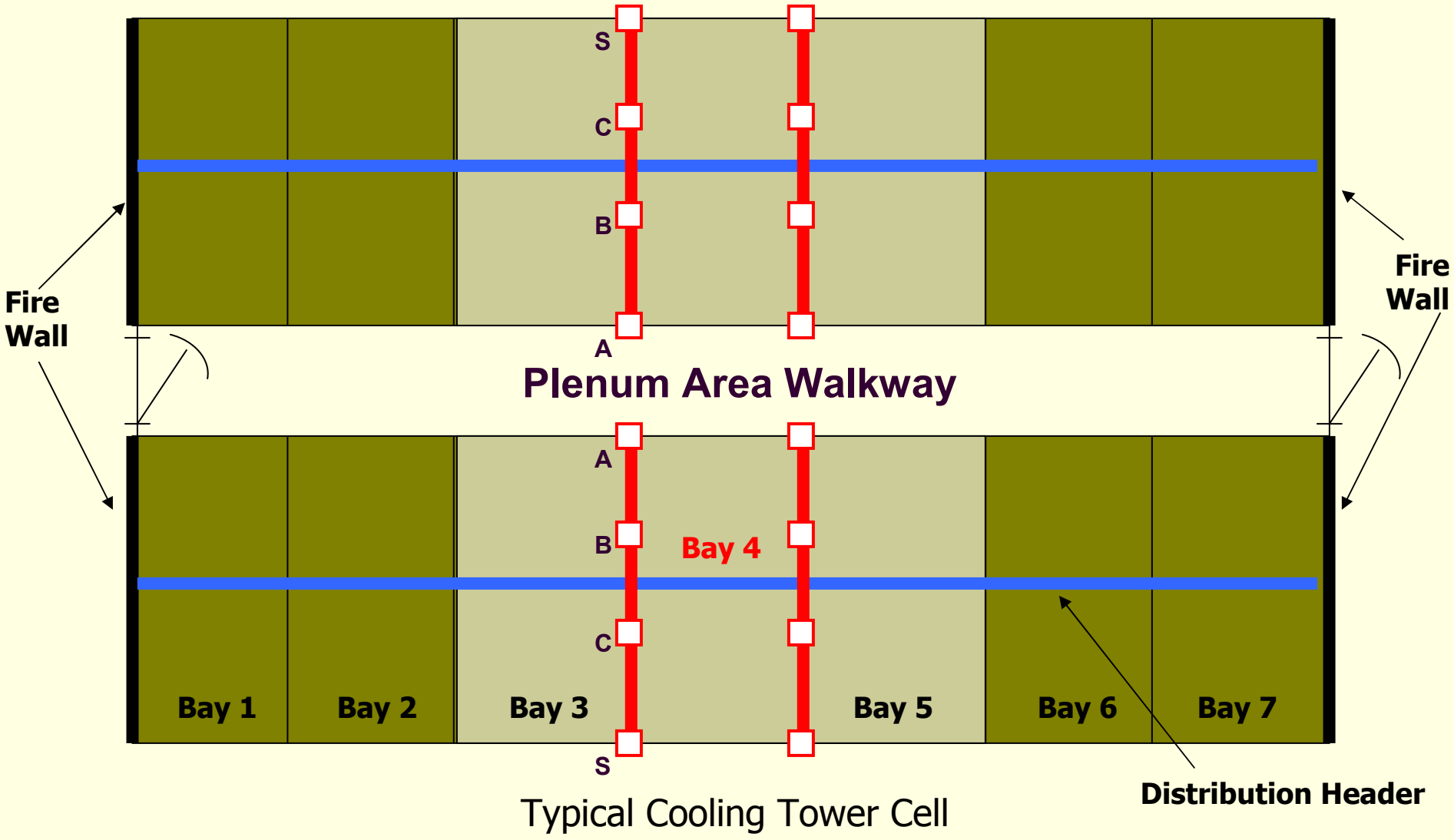
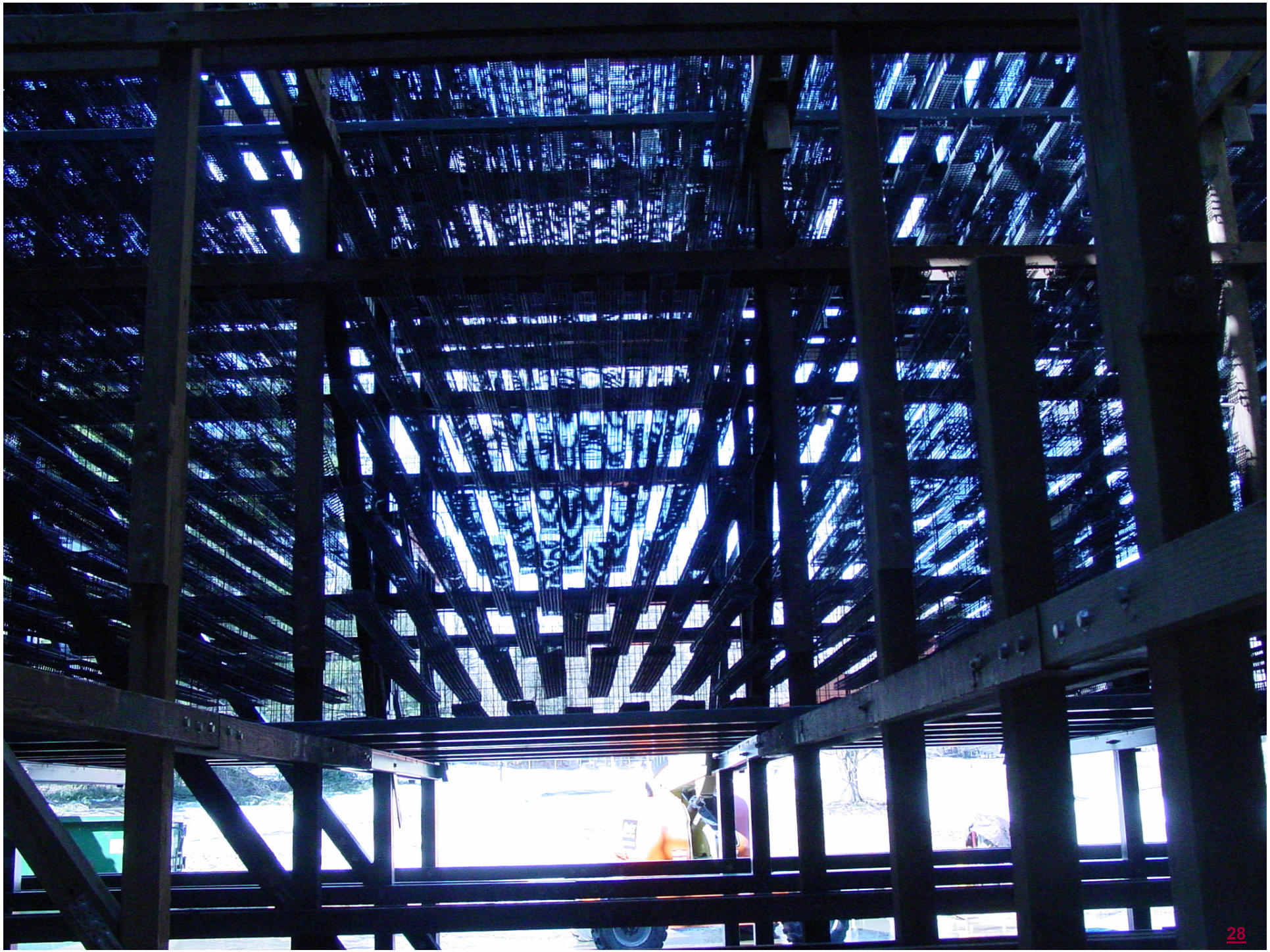
2008 Cooling Tower Project (Phase 1)



Typical Cooling Tower Cell


CAUTION
CAUTION



July 2008 Event

July 2008 Event

- **Field Observation**
  - Leak in Distribution Header (Cell 1-1 East, ~60 gpm)
  - Broken/Degraded Saddles (4 in tower 1, 2 in tower 2)

- **Cause of Event**
  - Wooden Saddle to FRP Connection
  - Identified by VY Design Engineering prior to placing tower in service
  - Incorrect Technical Assessment by Engineering/Vendor
  - Limited to FRP/Wood Saddles

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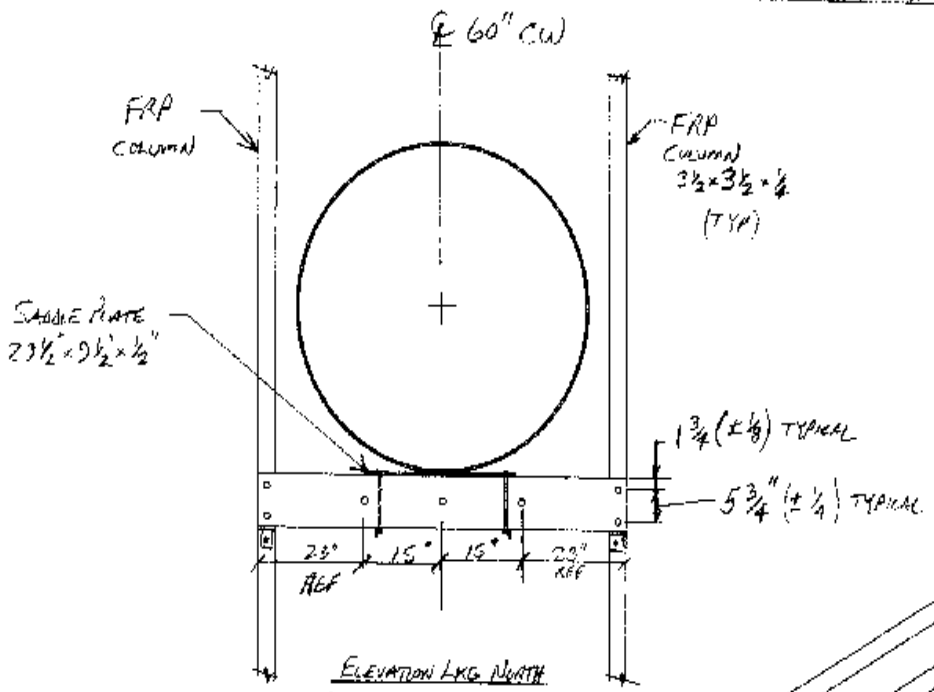
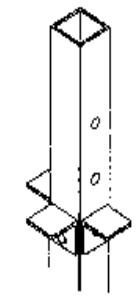
Cooling Tower 1 ; Circ. Water Supports

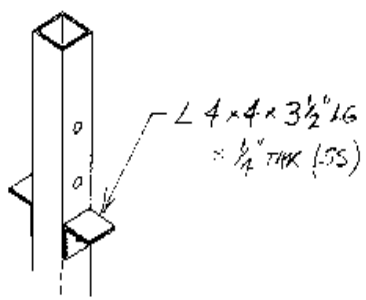
Typical Detail for Connection to FRP Columns



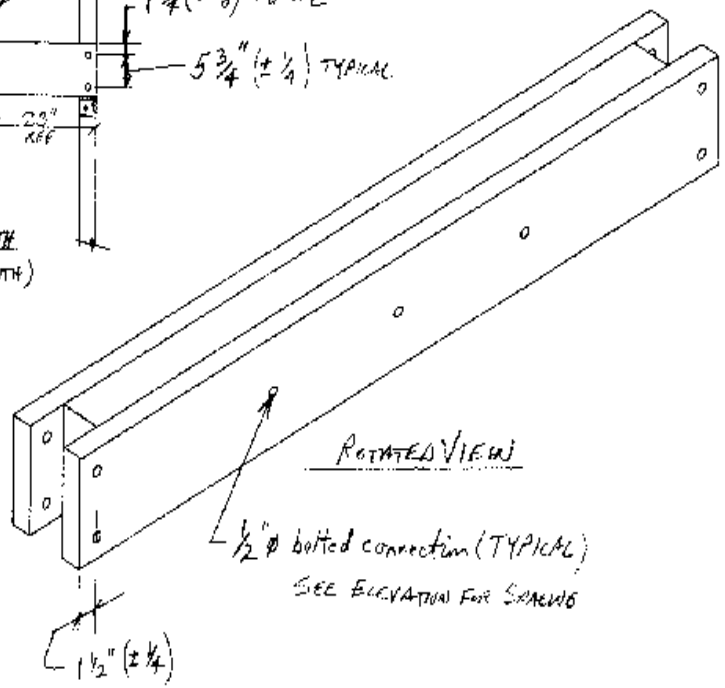
Elevation Lkg. North
(Similar for Lkg South)



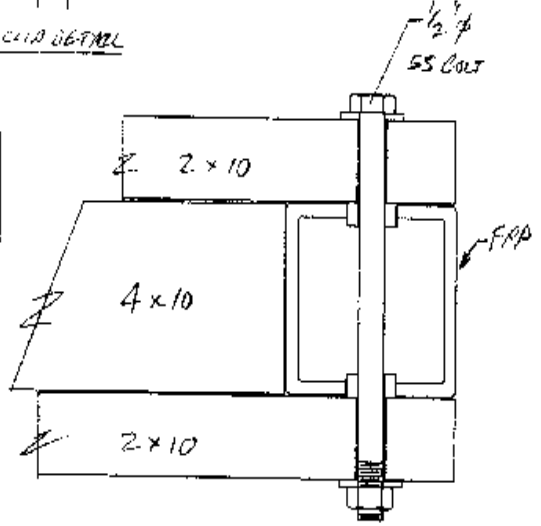
3 Clip Detail



2 Clip Detail



Rotated View



Entergy Vermont Yankee
Steven Buckley
7/12/08

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July 2008 Event

Corrective Actions

- Full extent of condition walkdowns
- Repaired all saddles/connections
- Revised design documentation

September 2008 Event

Distribution Header Leak – Initial Actions

- Operations Field Observations:
  - Potential depression in fan deck
  - Leak in distribution header piping
- Cooling water to towers promptly secured
- Remained at 100% plant power output for ~ 6 hours
- Lowered power to 55% due to river flow

Distribution Header Leak – Inspections

- Walkdowns performed using revised inspection procedures
- Leak NOT caused by structural problem
- Cause: Packing leak attributed to start/stop of cooling water pumps (not uncommon)
- Additional inspections - 8 degraded columns:
  - 1 Level 1 - replace; unrelated to leak
  - 3 Level 2 adjacent to Level 1 - replace
  - 4 Level 2 – address next maintenance window

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Inspection Acceptance Criteria

- **Level 1: Replace immediately**
- **Level 2:**
  - ✓ **If adjacent to Level 1, replace immediately**
  - ✓ **Otherwise, replace next maintenance period**
- **Level 3: Inspect/monitor**

Distribution Header Leak – Corrective Actions

- Leak repaired
- Replaced support columns

Cooling Tower Event Summary

Cooling Tower Event Summary

- Safety function not affected
- Maintained compliance with federal/state discharge permit
- No impact from power uprate
- Revised Inspection procedures/organizational sensitivity effective
- Substantial investment in reliability improvements

Long Range Plan

Long Range Plan

- Phased approach based on maintenance availability
  - Phase 1: Bay 4 Complete
  - Phase 2: Bay 2 Spring 2009
  - Phase 3: Bay 6 Spring 2010
- Other inspections/repairs based on revised methods/procedures

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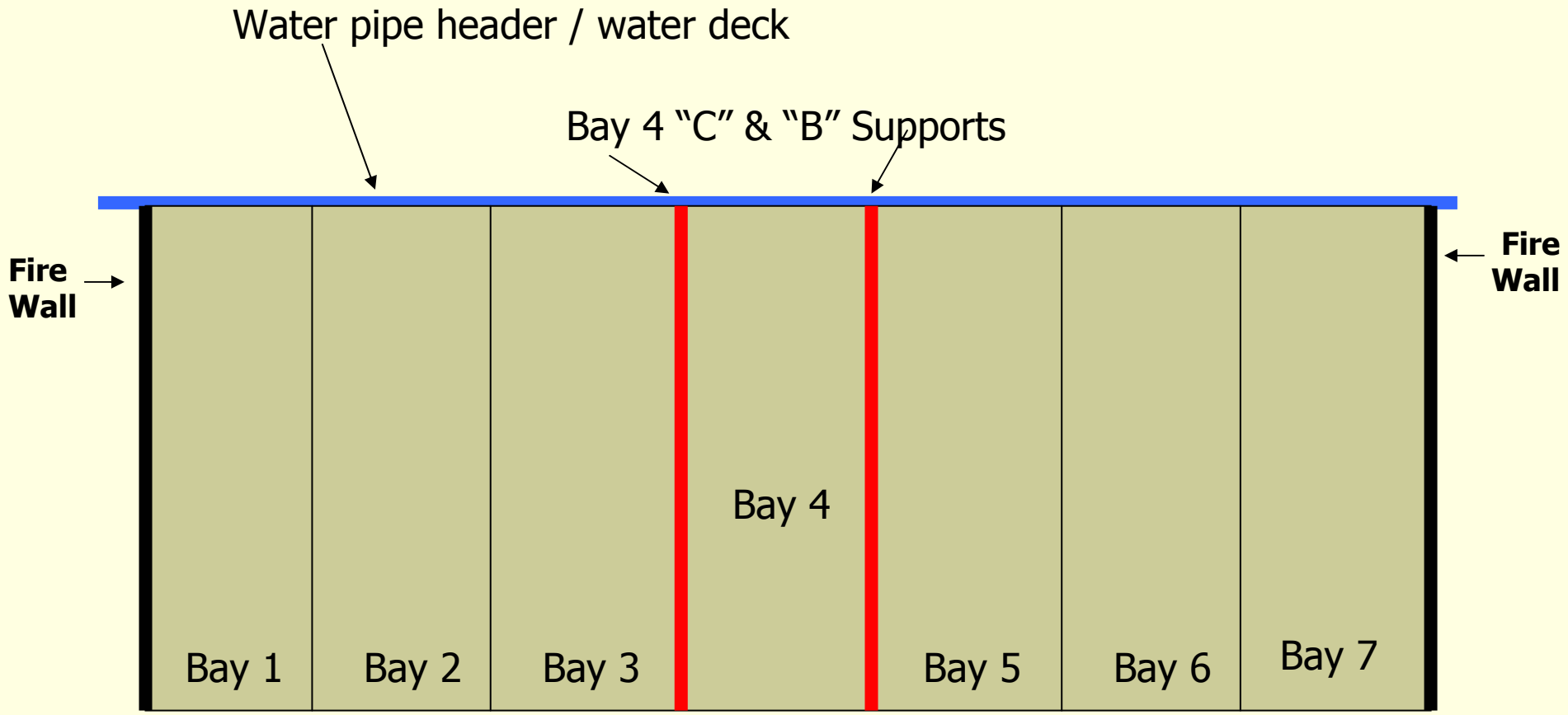
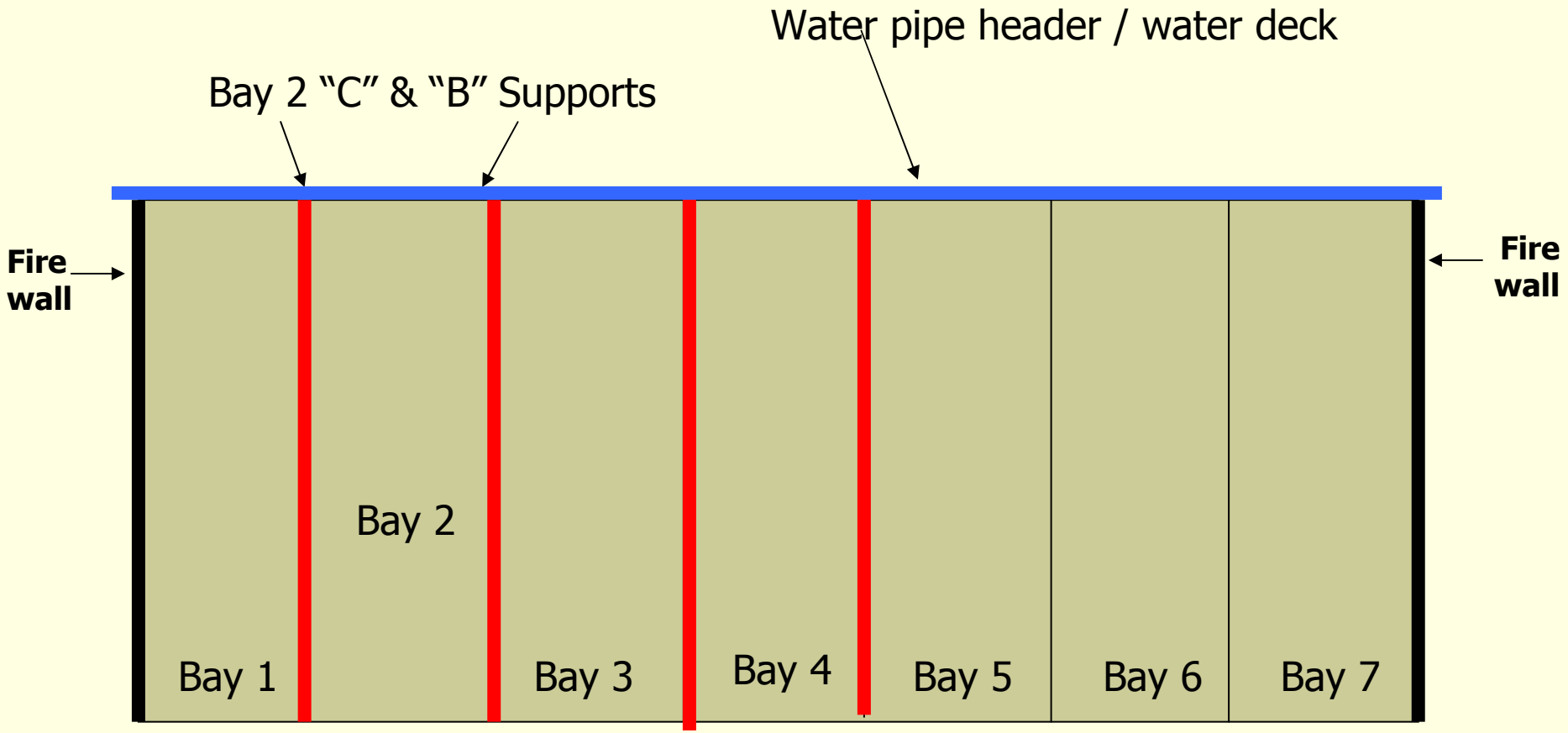
Phase 1



Typical Cooling Tower Cell

Entergy

Phase 2



Typical Cooling Tower Cell

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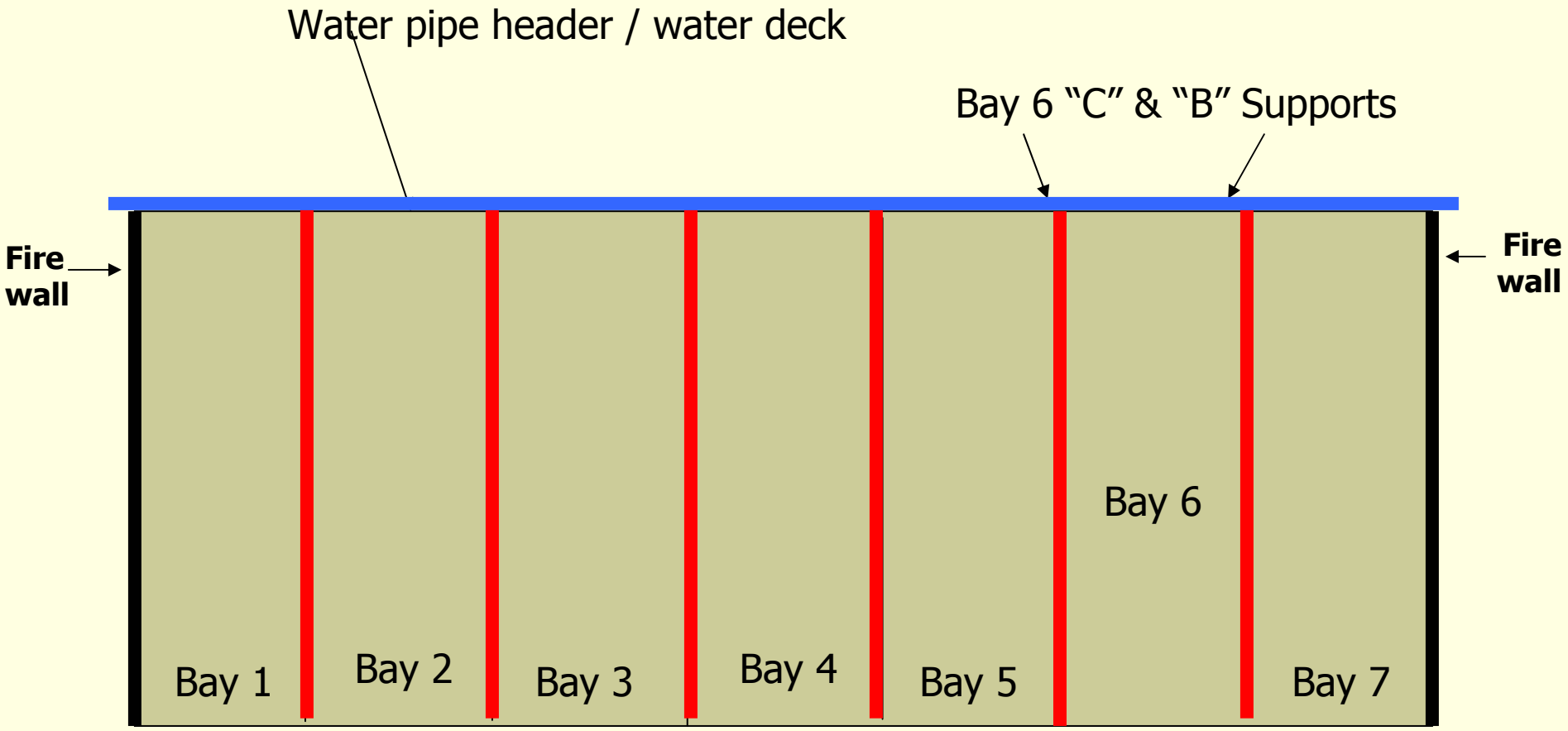
Phase 3



Typical Cooling Tower Cell