

IAPG
Jornadas de Producción
Instalaciones de Superficie
18 y 19 Setiembre 2003

**Diagnóstico de torres de
destilación o despojadoras
por Gamma Scanning**

Tru-Tec / Xycon-Flox S.A.

**Martín Rizo, Osvaldo Ucha, Leonel Altamirano,
Pablo Sancez, Ingrid Ljungmann.**

Traditional Methods of Unit Operation Troubleshooting

- **Field Experience**

- **Past History**
- **Senior Personnel**

- **Quantitative Data**

- **Temperatures or Delta Ts**
- **Pressures or Delta Ps**
- **Flow Rates**
- **Liquid Levels**
- **Compositions**

- **Trial-and-Error**

- **Cause and Effect Analysis**
- **Brainstorm**

- **“Rigorous” Analysis**

- **Computer Simulation**

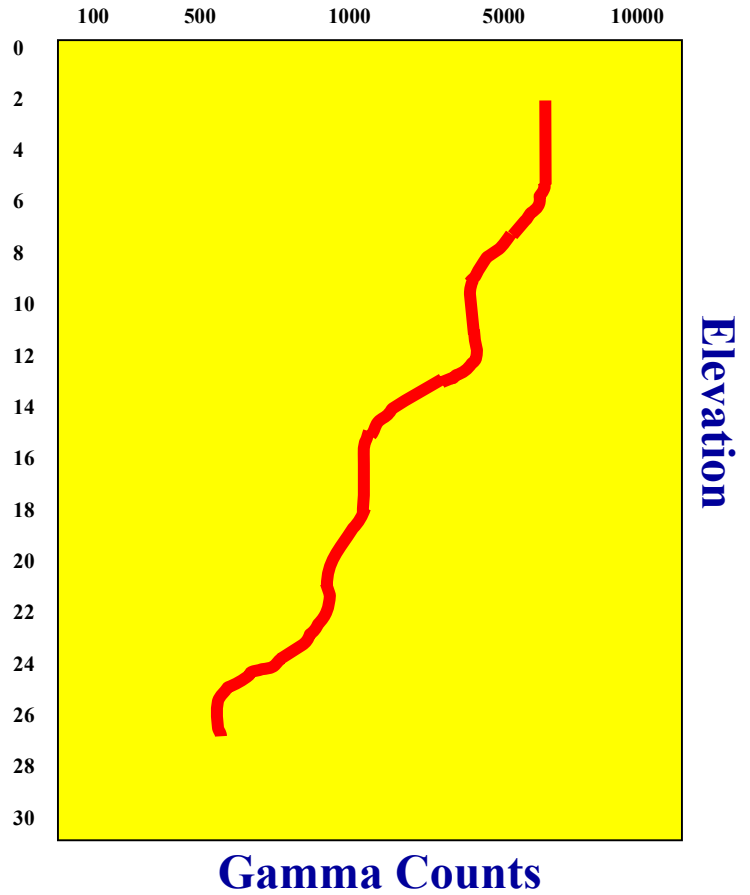
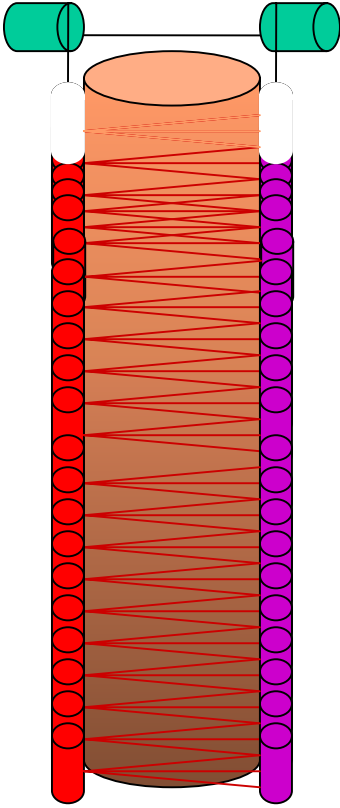
- **Shutdown Inspection**



•On line Process Diagnostics

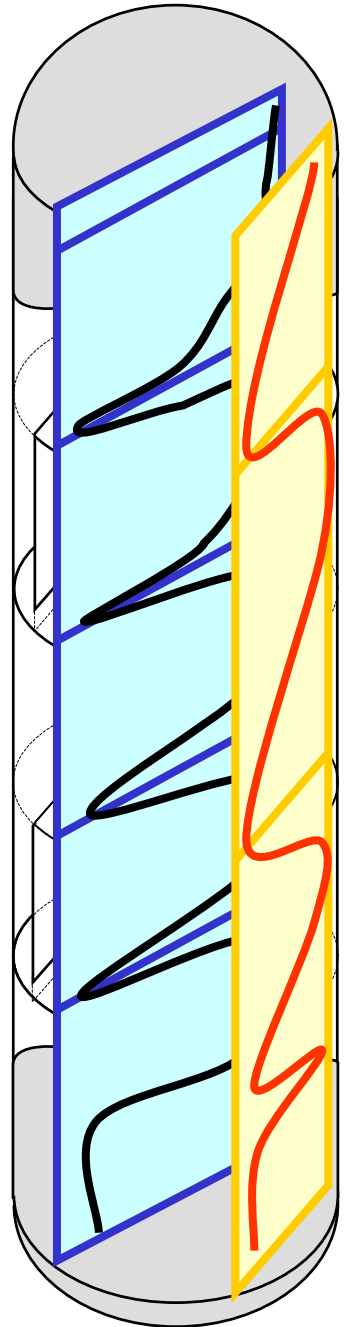
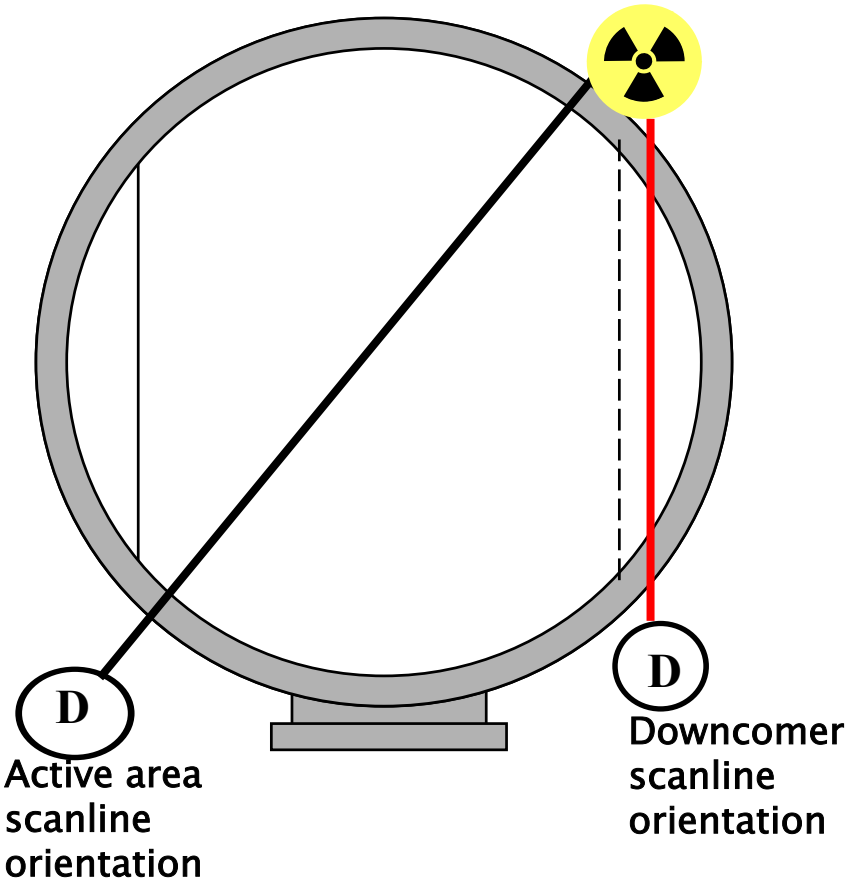
- Distillation Column Scanning
- Radioactive Tracing
- CAT-Scan
- FCC Reactor Diagnostics
- Neutron Backscatter
- Helium Leak Testing
- Scan/Simulation Integrated Diagnostics
- Knowledge Base

Gamma Scan



$$\ln\left(\frac{I}{I_o}\right) = \sum \mu_i \rho_i x_i$$

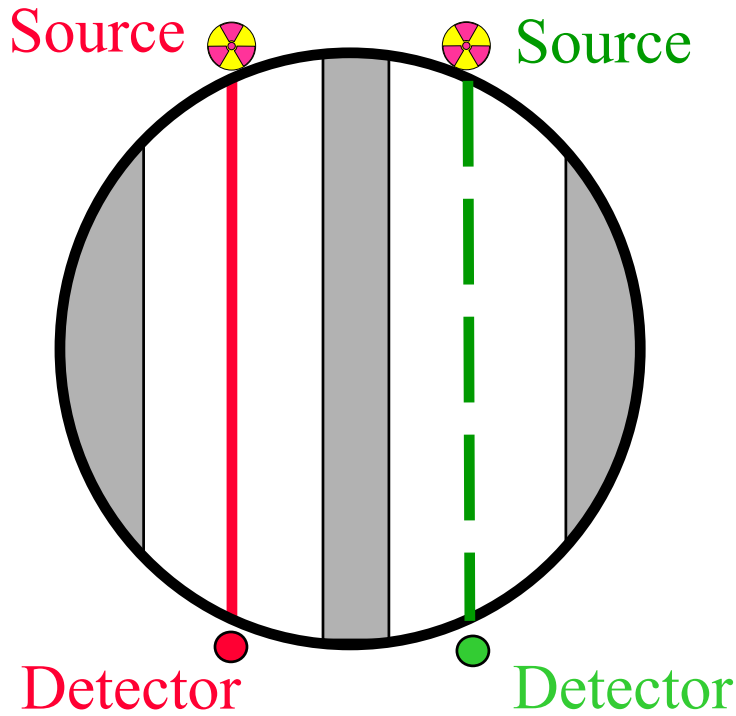
Gamma-Scanning



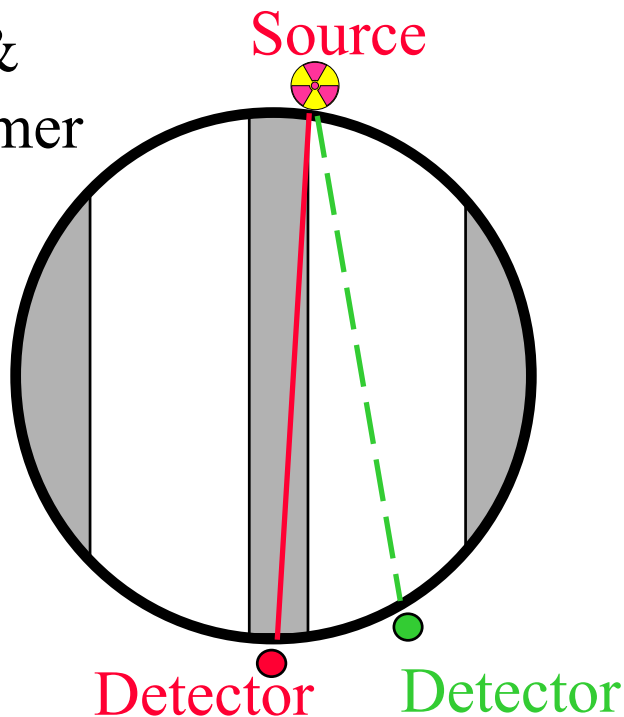
Scanning Trayed Towers

Active Areas & Downcomers

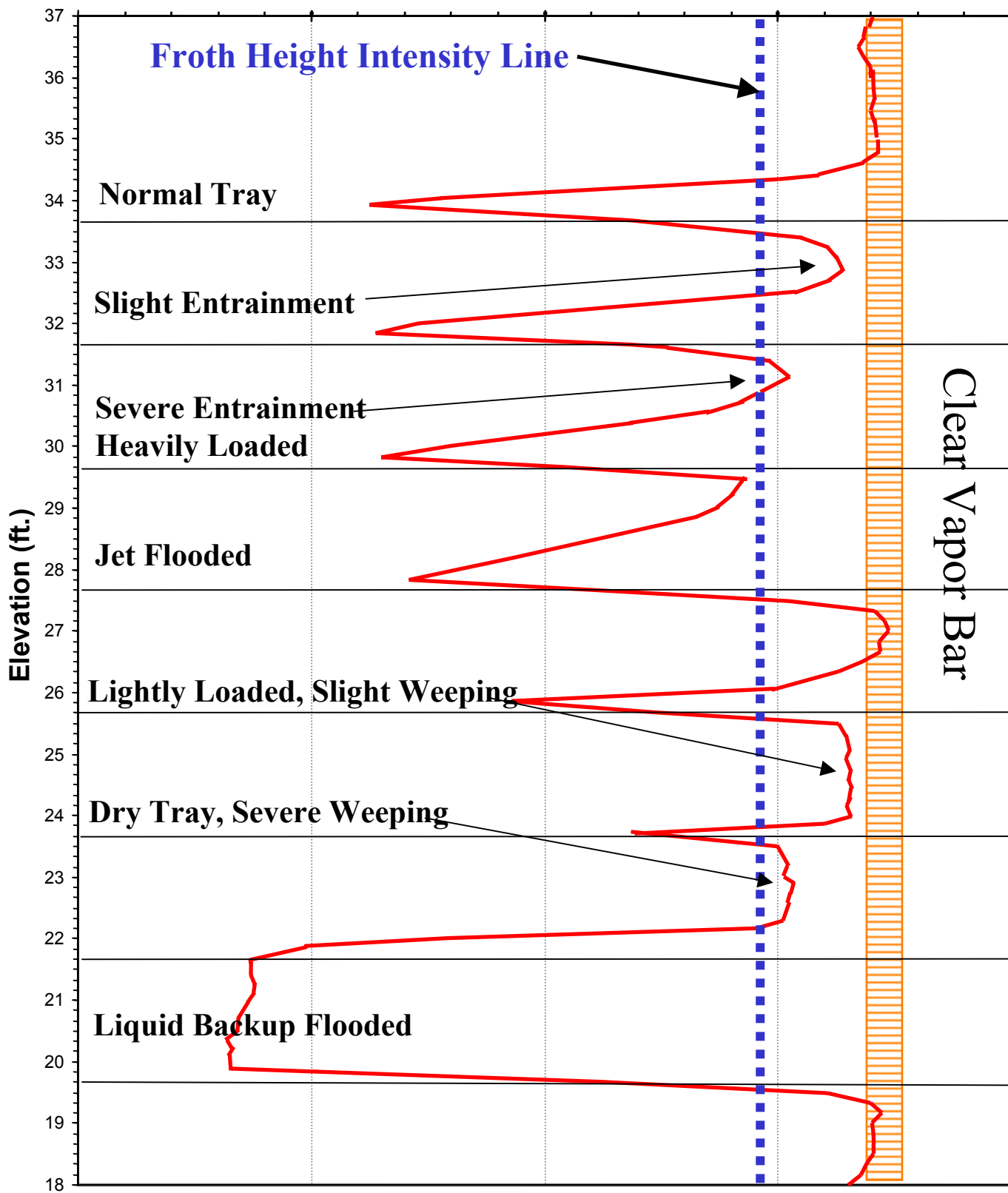
Two Pass Trays



Concurrent
Active Area &
Center Downcomer



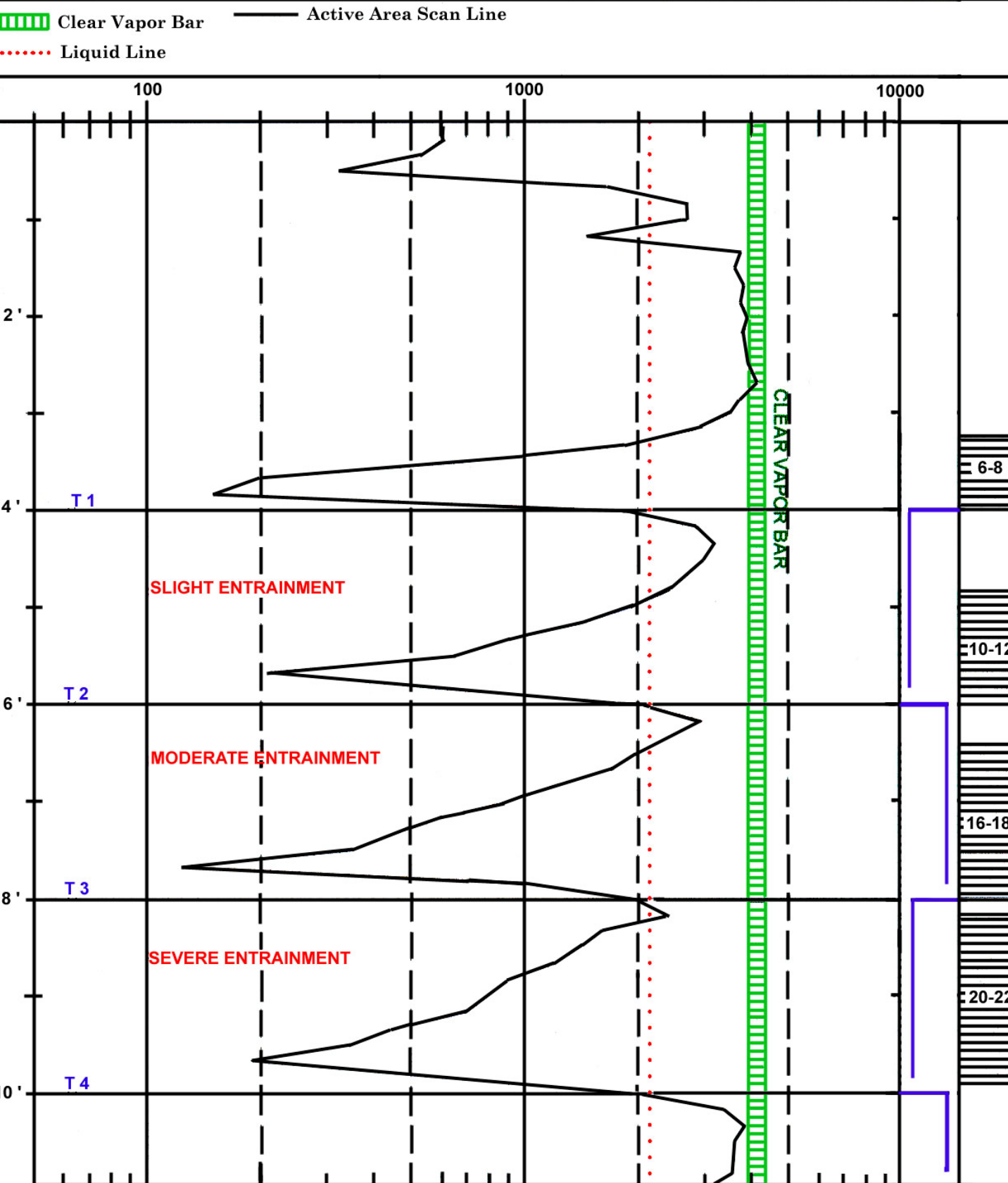
Radiation Intensity



Sample Scan Figure 2

TRAY ENTRAINMENT

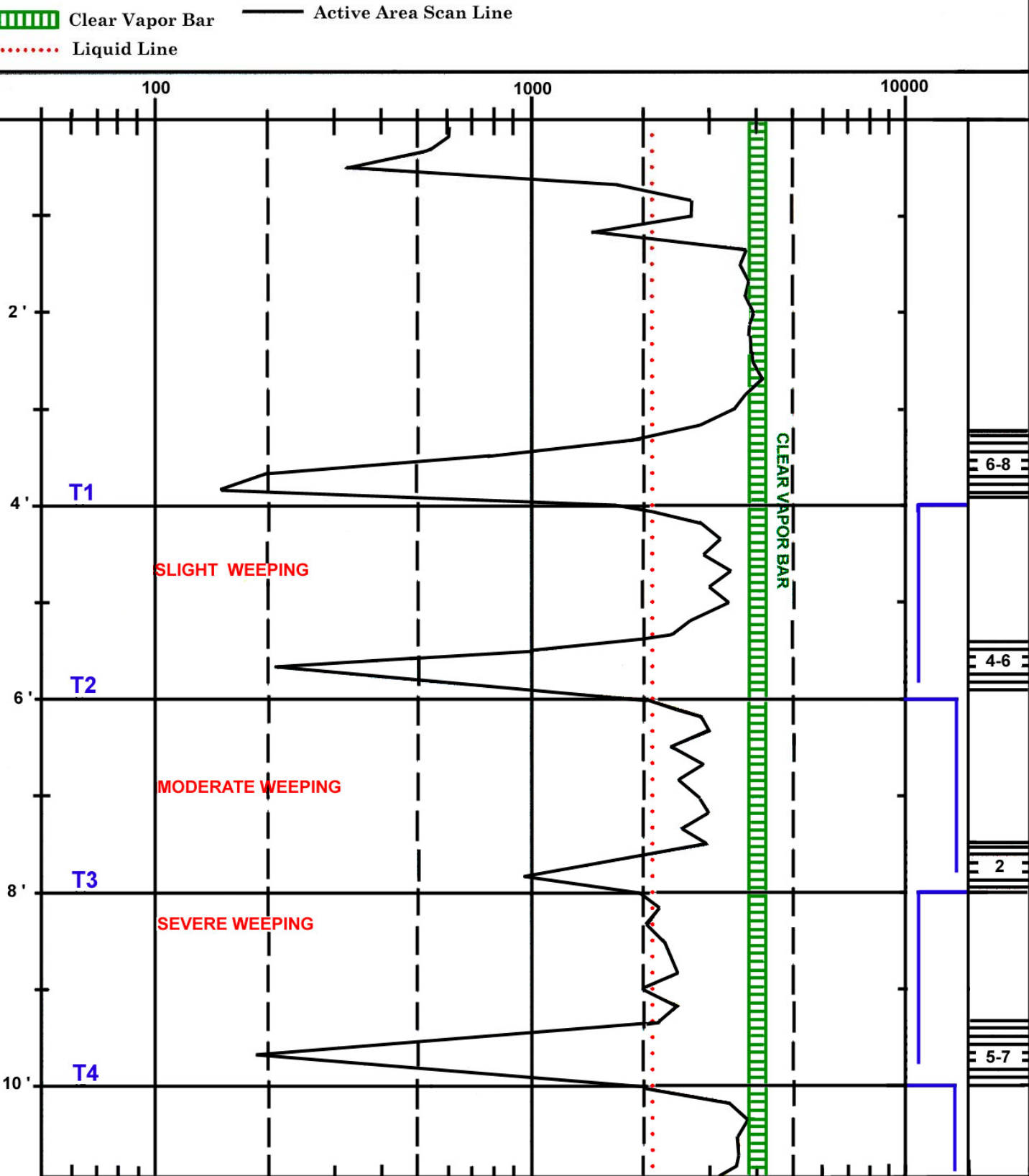
Scales: 50 - 10000



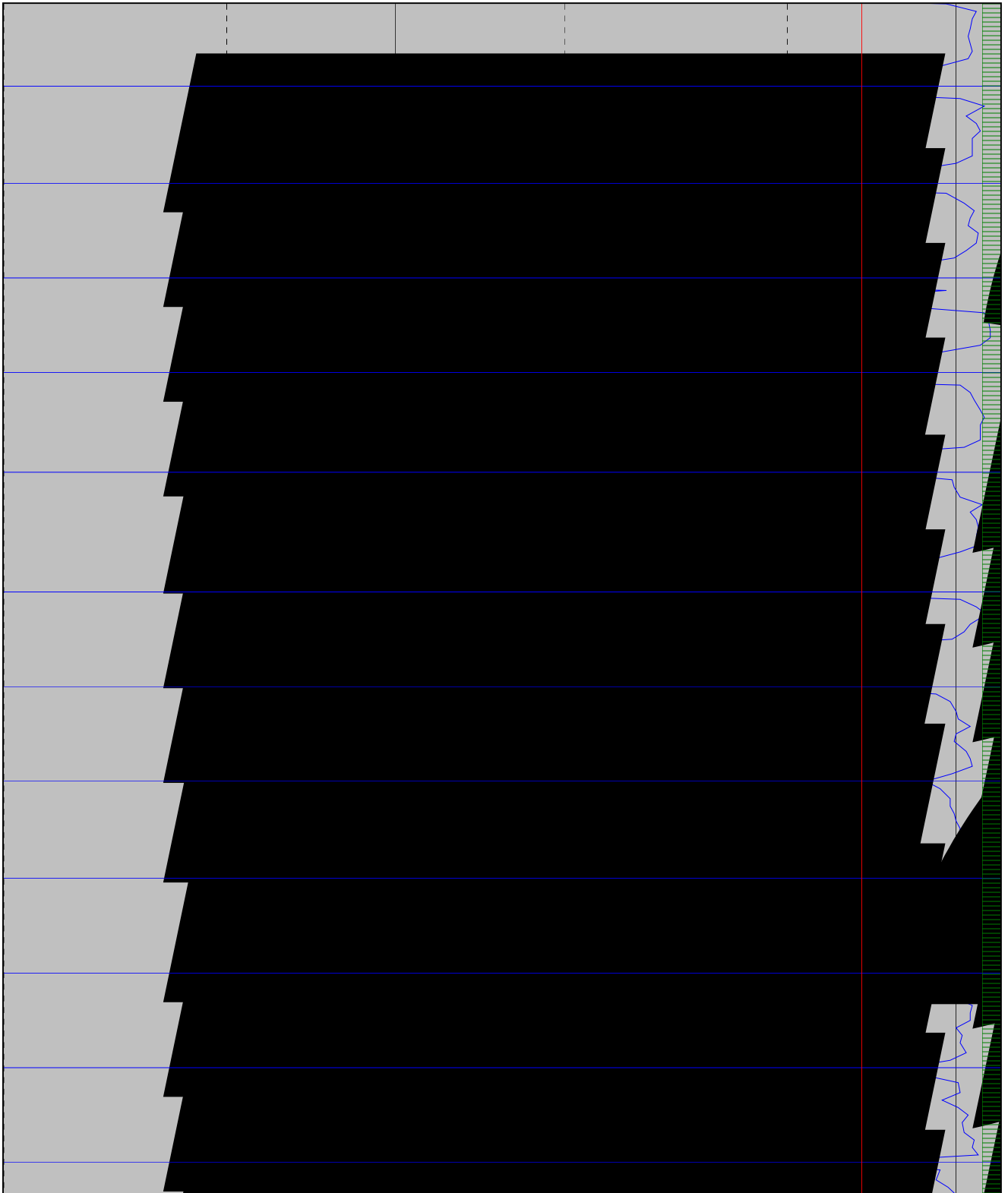
Sample Scan Figure 3

WEEPING TRAYS

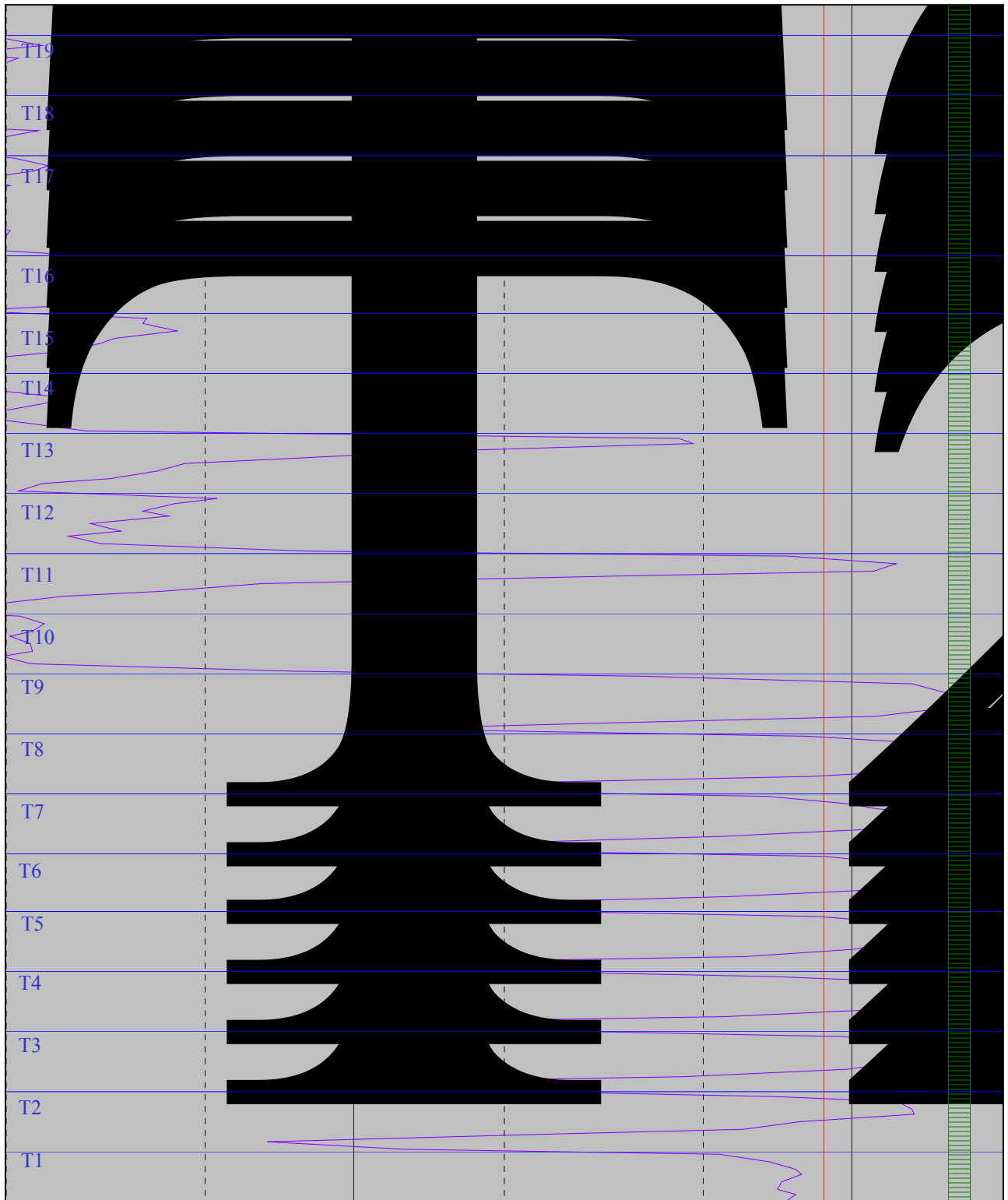
Scales: 500 - 10000



Damaged Trays



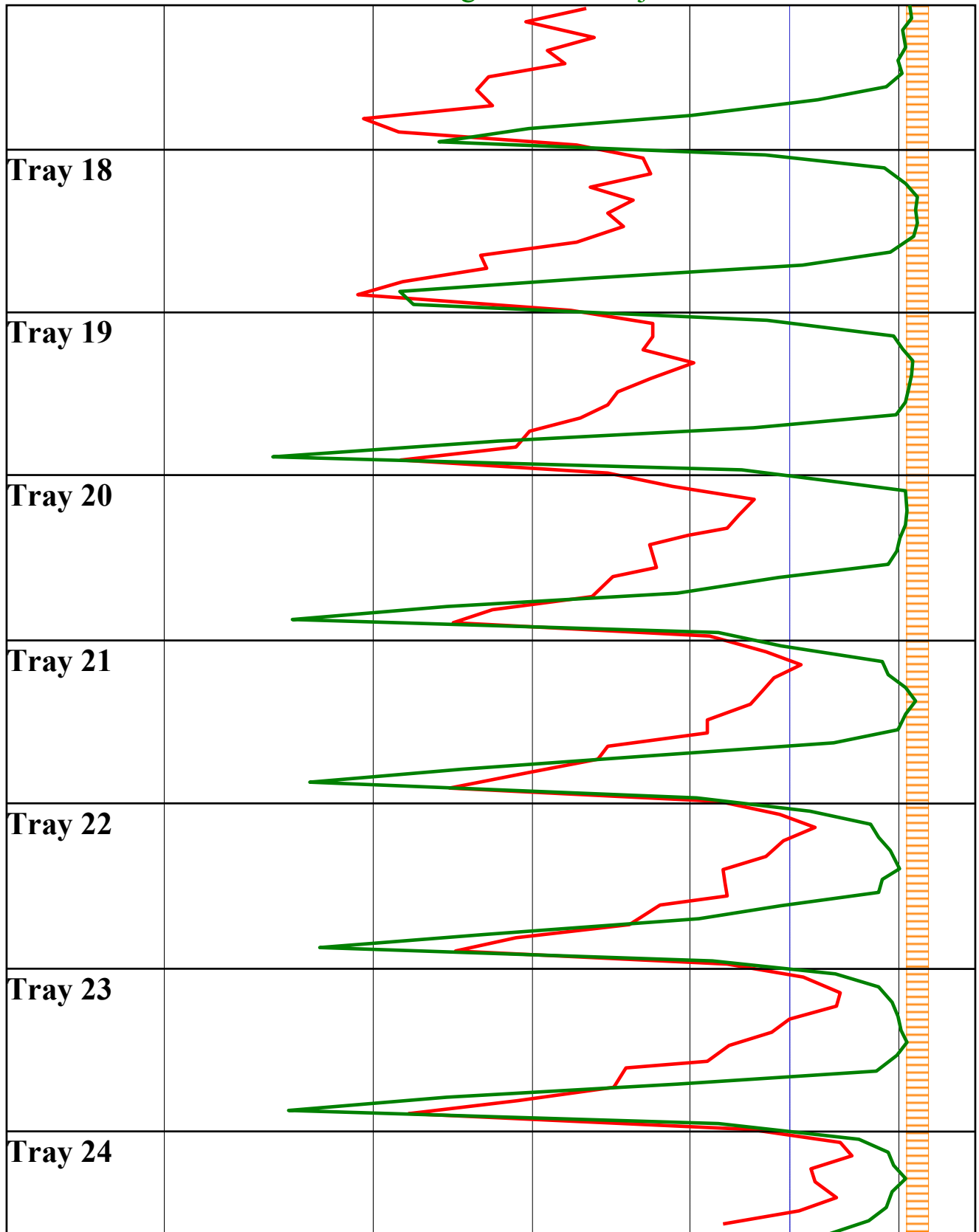
Flooded Trays



Example of Foaming Amine Regenerator Column

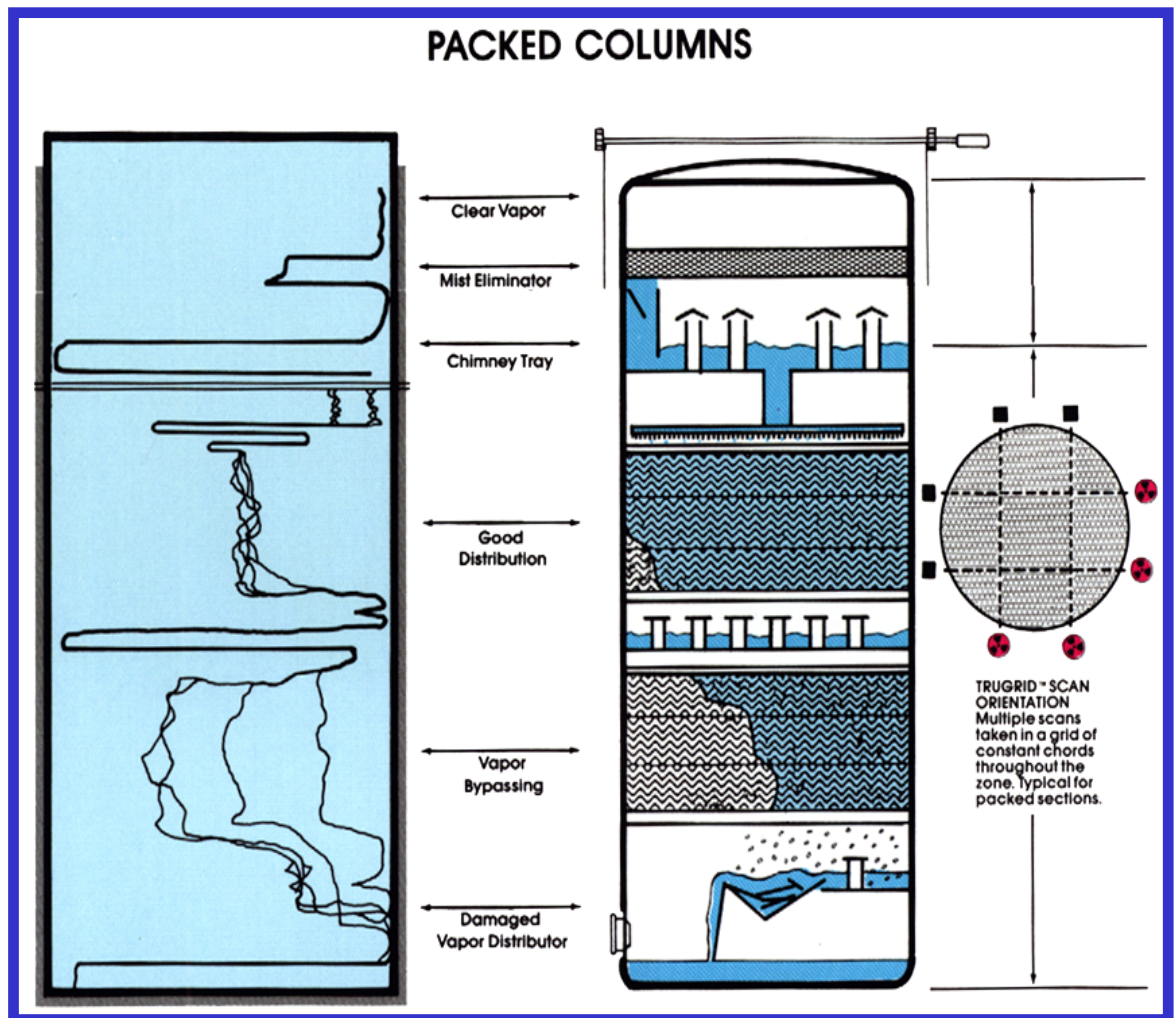
Red Curve: Initial Scan

Green Curve: Second Scan following anti-foam injection



Grid Scan

Scanning can identify a number of common malfunctions in columns



Mechanical

- Damage to trays and packings
- Corrosion resulting in partial tray damage
- Missing tray manways
- Out-of-place liquid or vapor distributors
- Level control problems in the base of the column

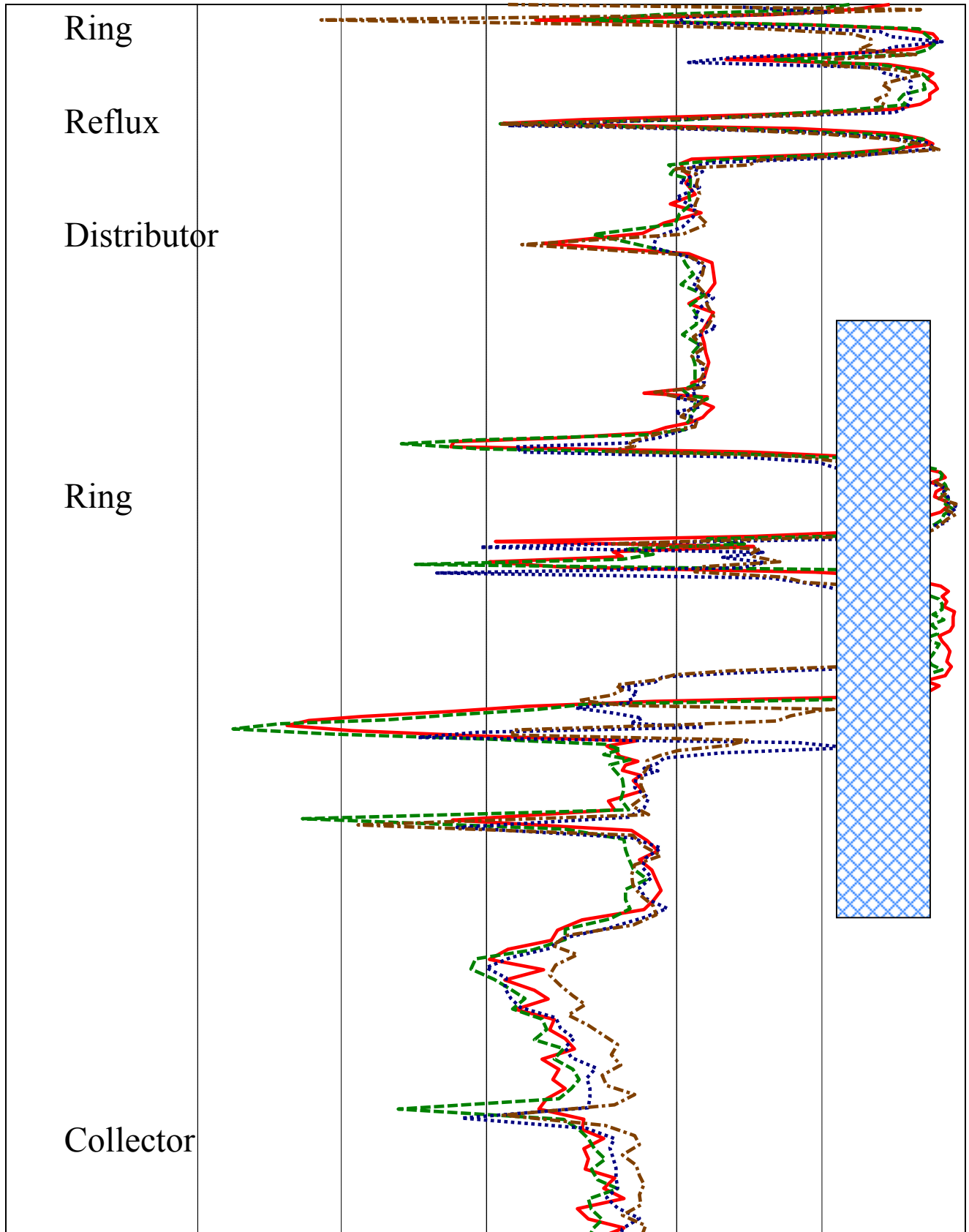
Rate Related

- Entrainment (slight, moderate, severe, jet flooding)
- Weeping
- Dry or flooded trays due to loading conditions

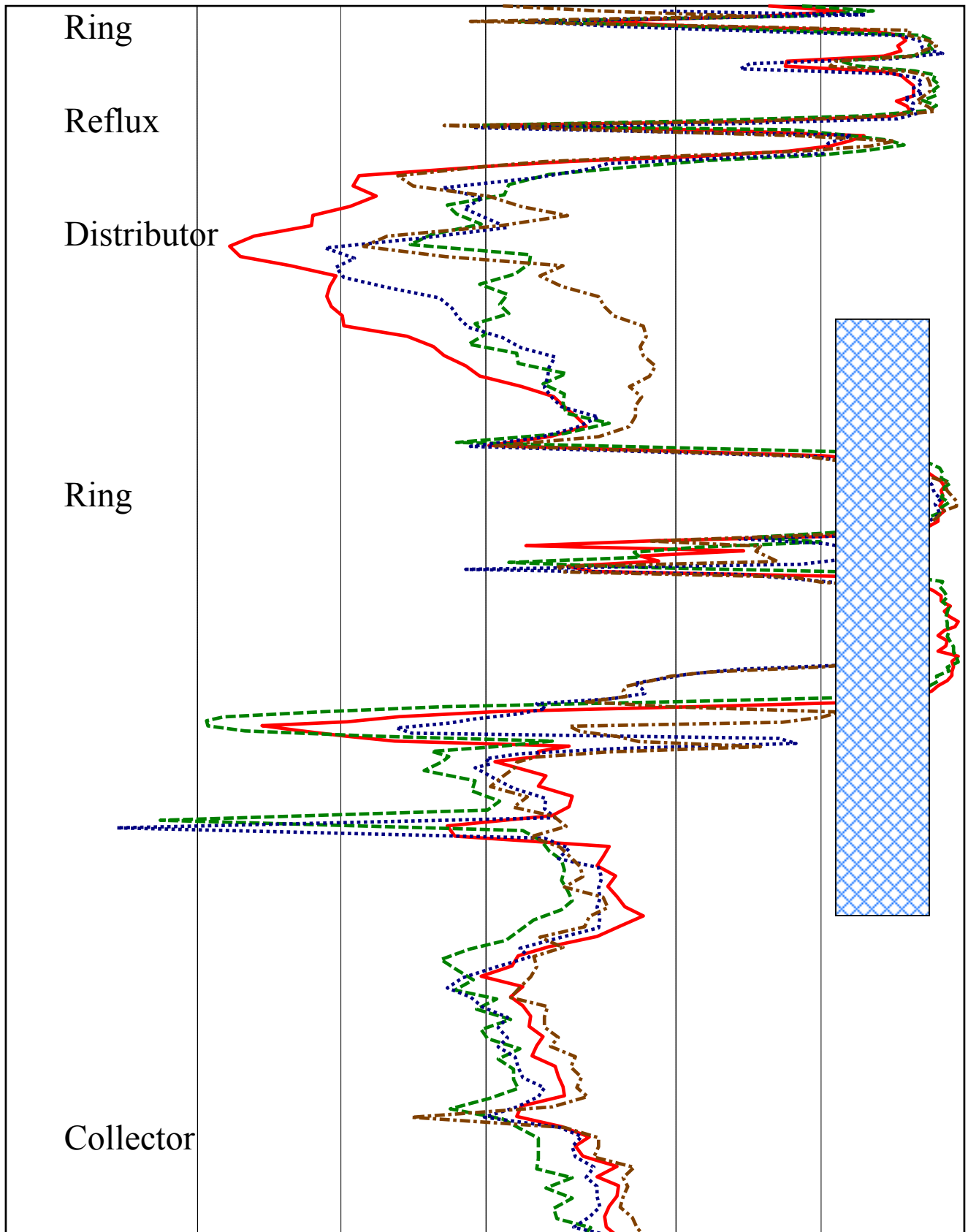
Process Related

- Foaming
- Liquid holdup due to fouling or pluggage
- Superheated or subcooled feed or reflux

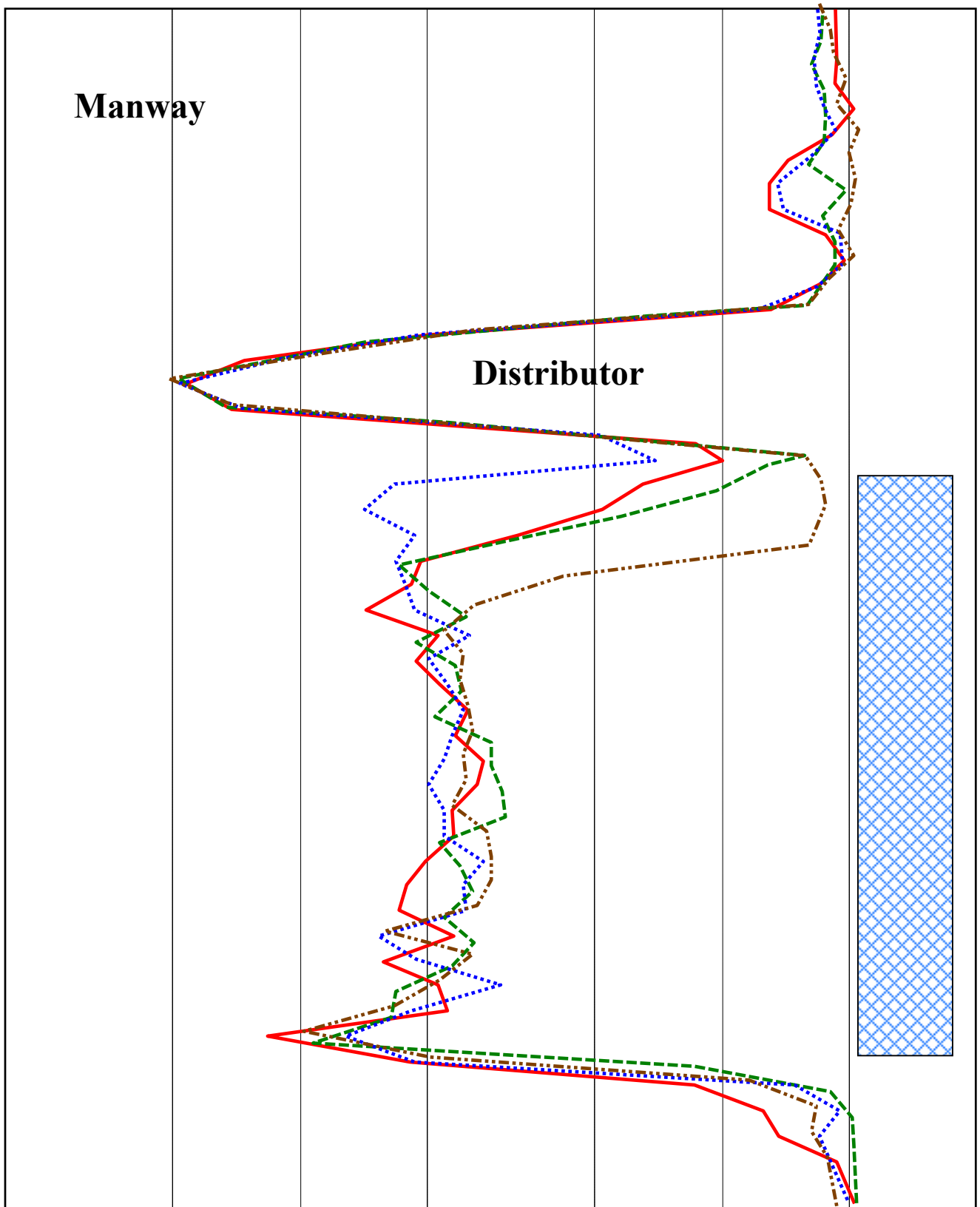
Example: Good Distribution Packed Stripper Column



Example: Poor Distribution and Fouling Packed Stripper Column



Example: Damaged Packing Stripper Column

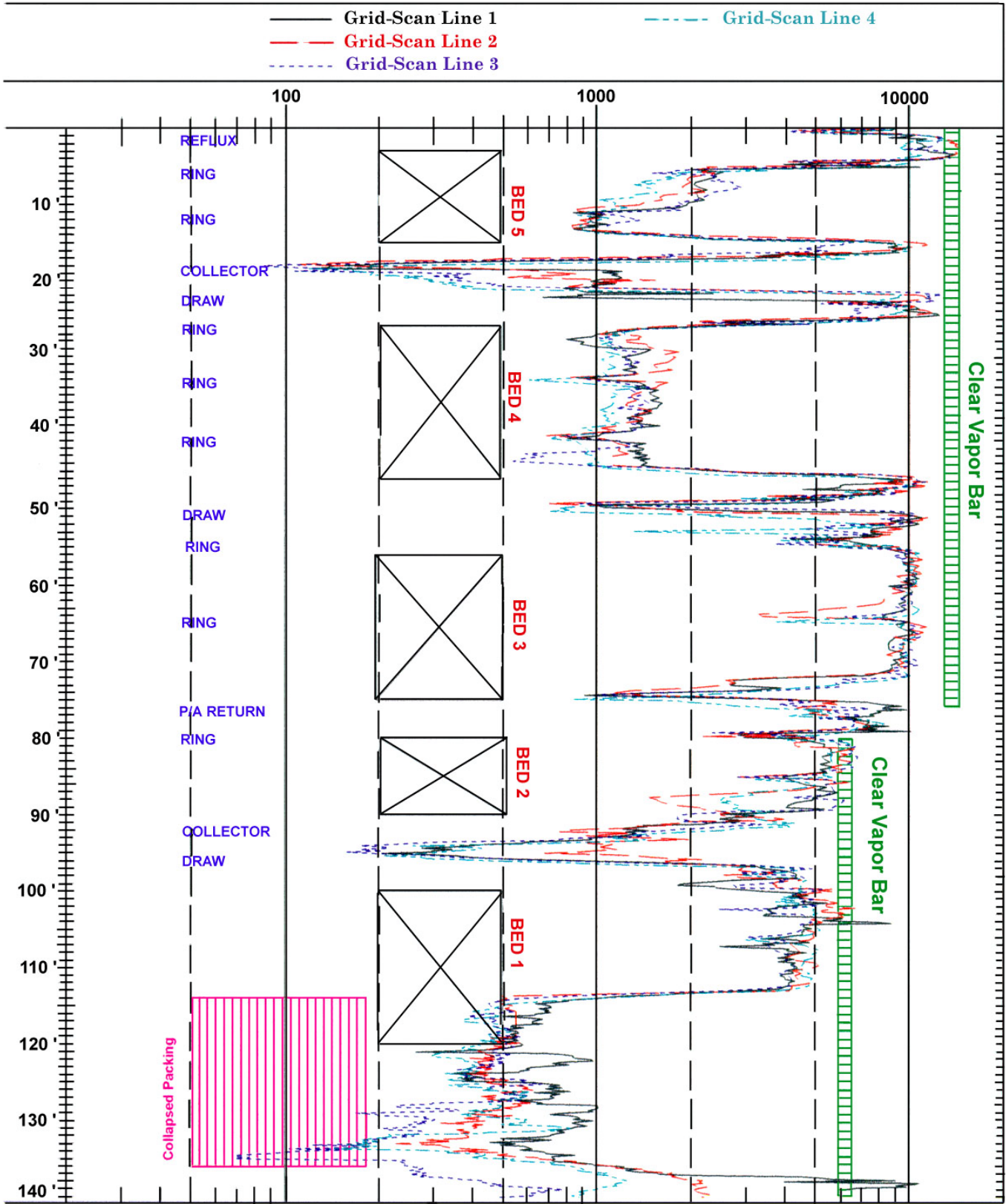


Sample Scan Figure 8
COLLAPSED PACKING BEDS



Tru-Tec Services, Inc.
Process Diagnostics
(800) 288-8970 toll free US & Canada
(281) 471-8970 outside US
<http://www.tru-tec.com/>

Scales 20 - 20000



Plugged Structured Packing

Sample Scan Figure 7

PLUGGED STRUCTURE PACKING BED

Scales: 50 - 30000



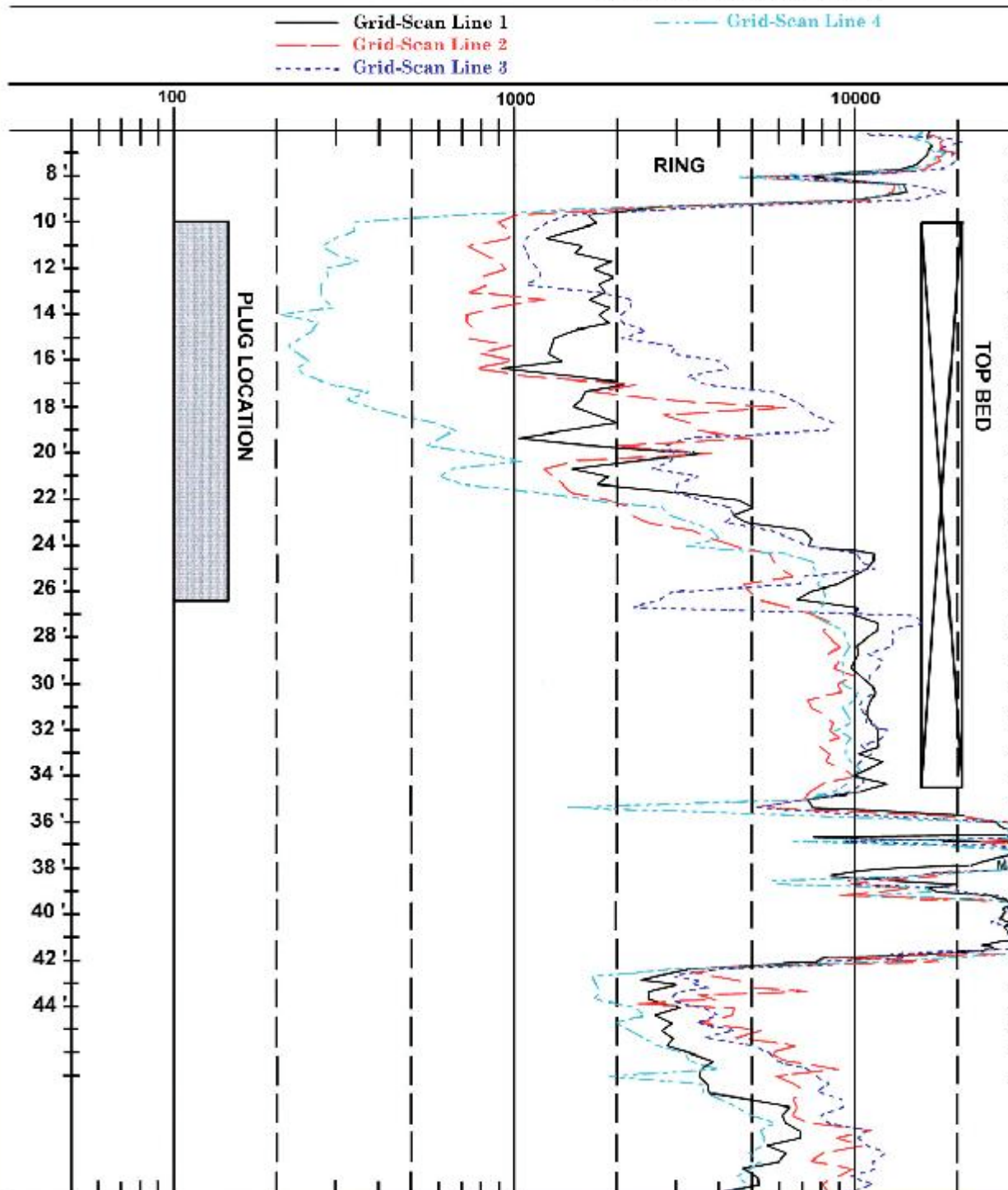
Tru-Tec Services, Inc.

Process Diagnostics

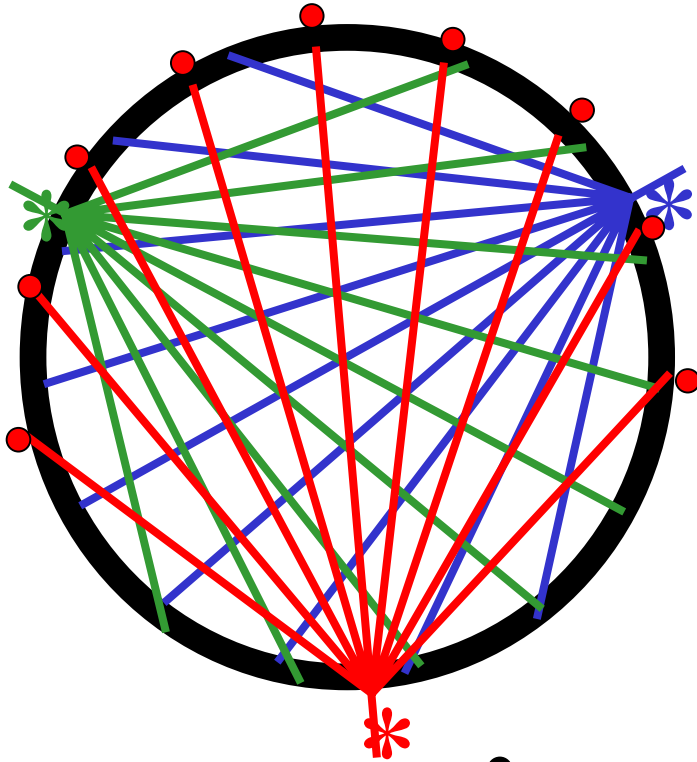
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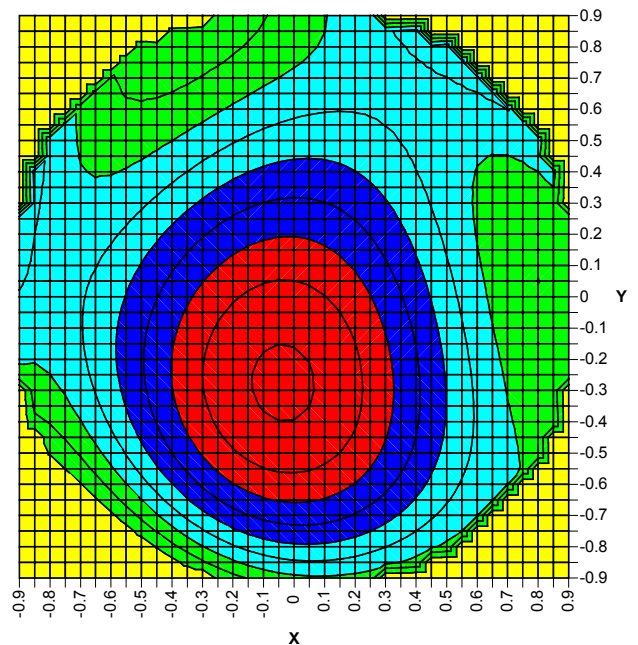


CAT-Scan



Source Placement

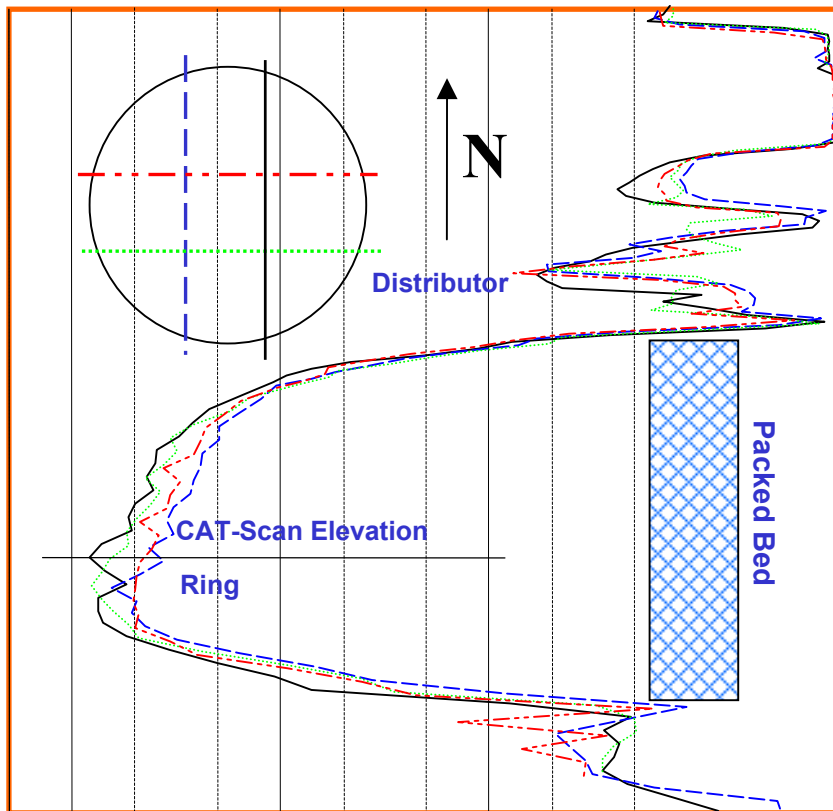
● Detector Placement



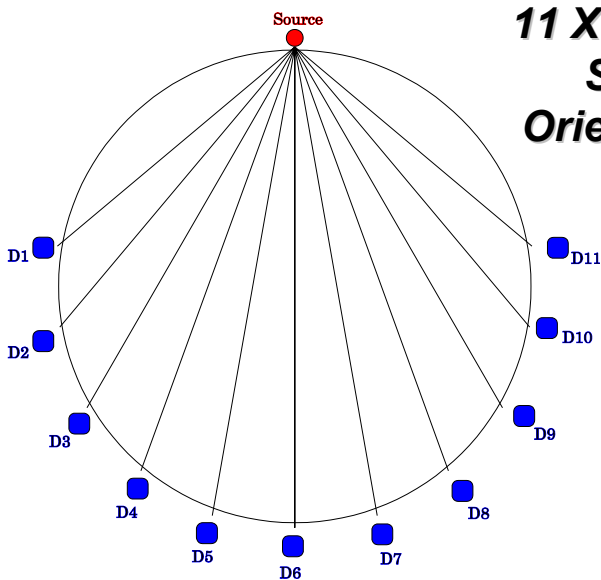
CAT-Scanning Technology

(Computer Aided Tomography)

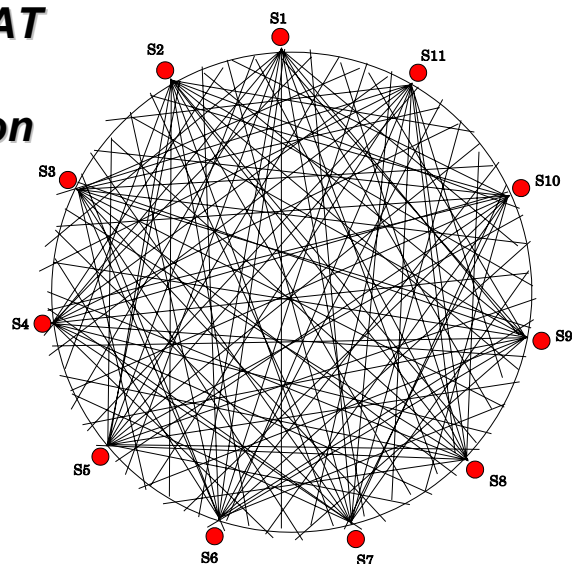
Applied to Packed Beds



**11 X 11 CAT
Scan
Orientation**

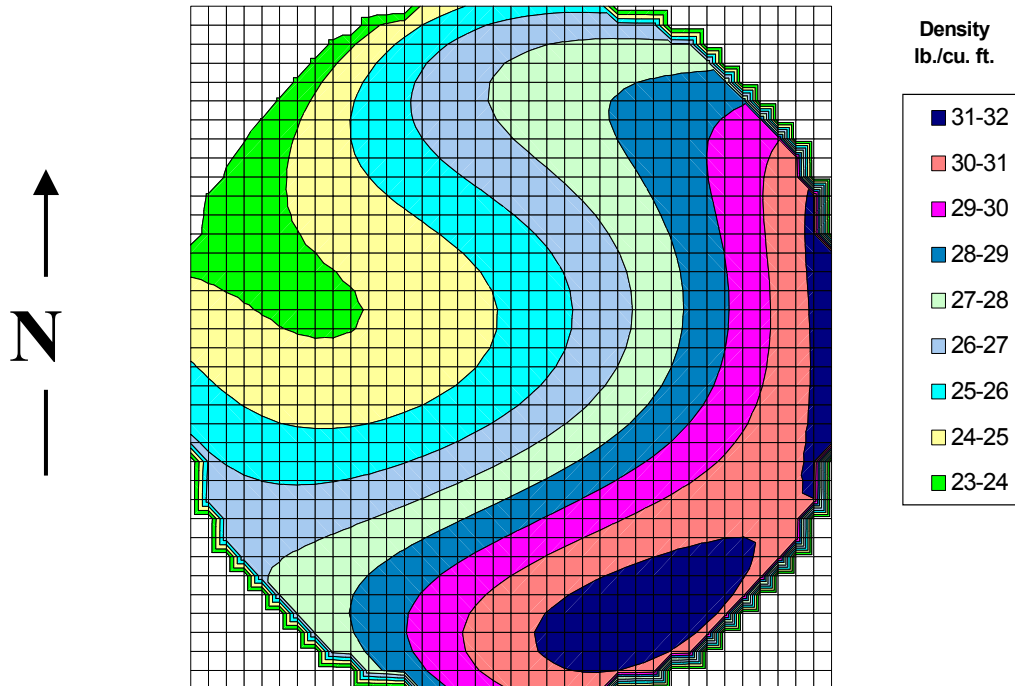


**11 detector chords
per source fan
beam**

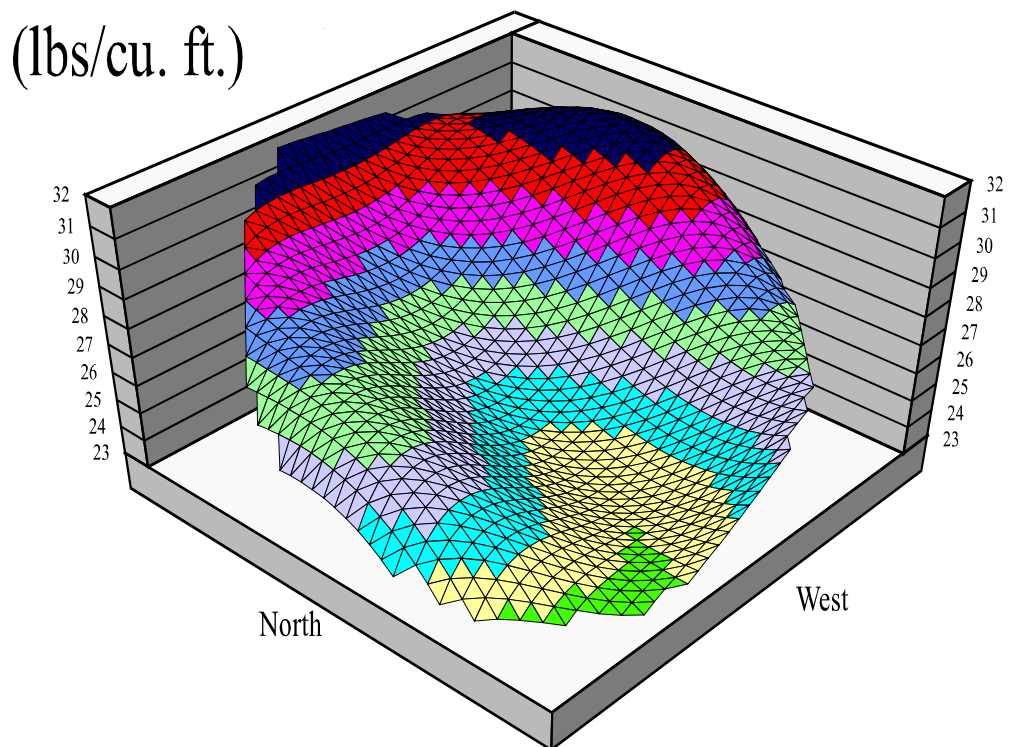


**11 source fan beams for a
total of 121 scan chords**

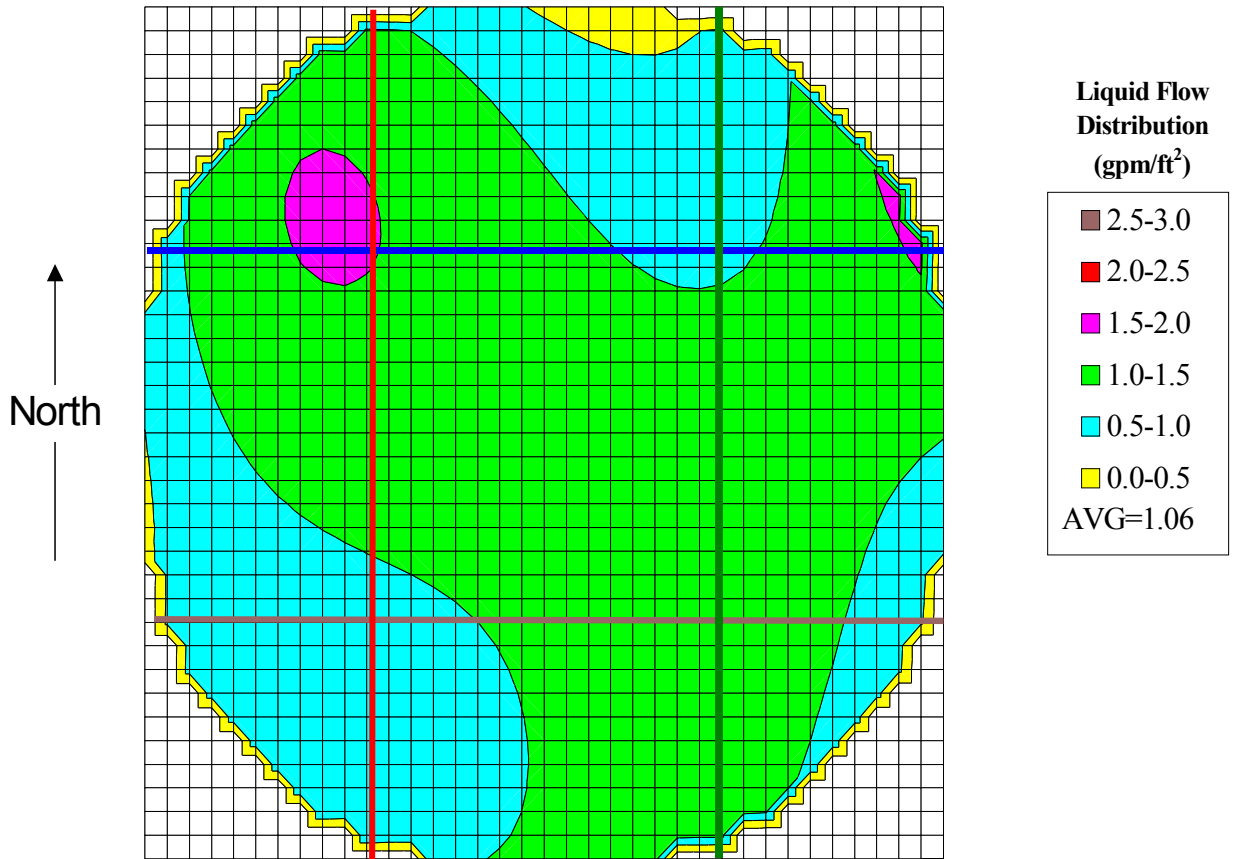
Packed Column
Contour Plot



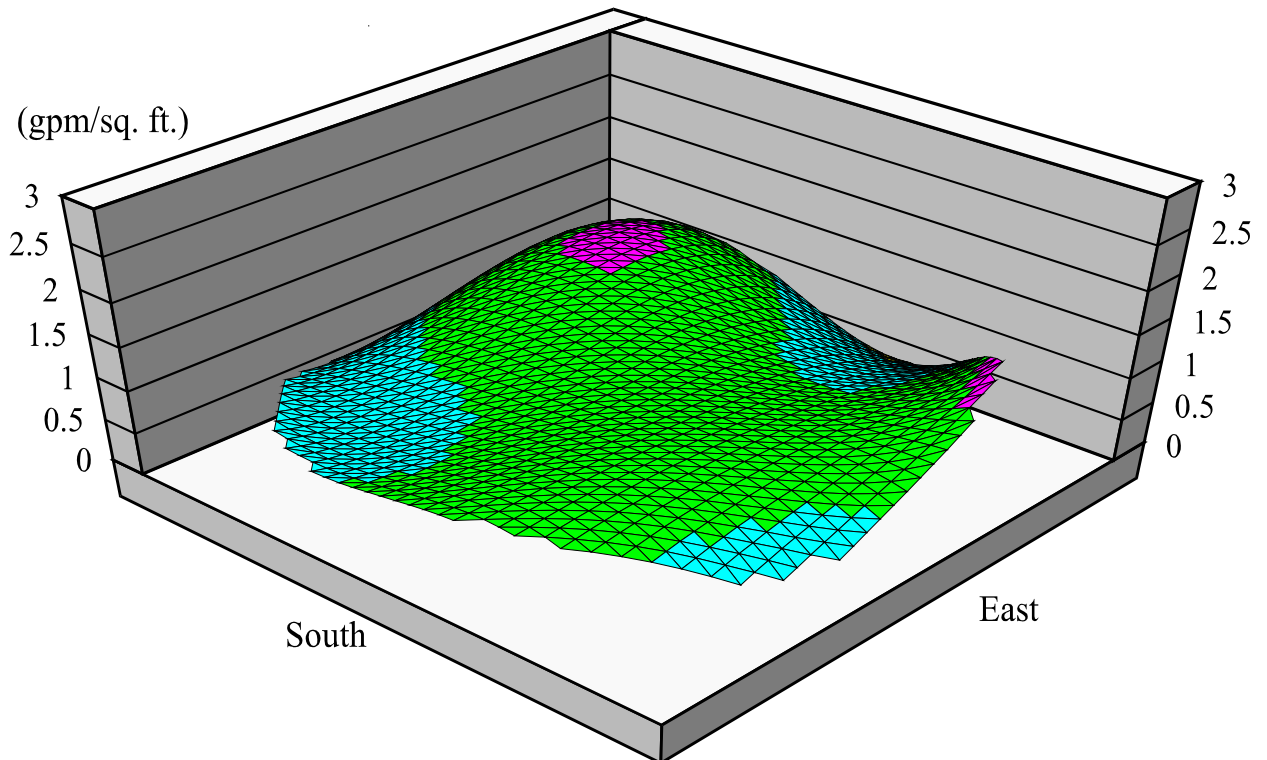
3-D Surface Plot



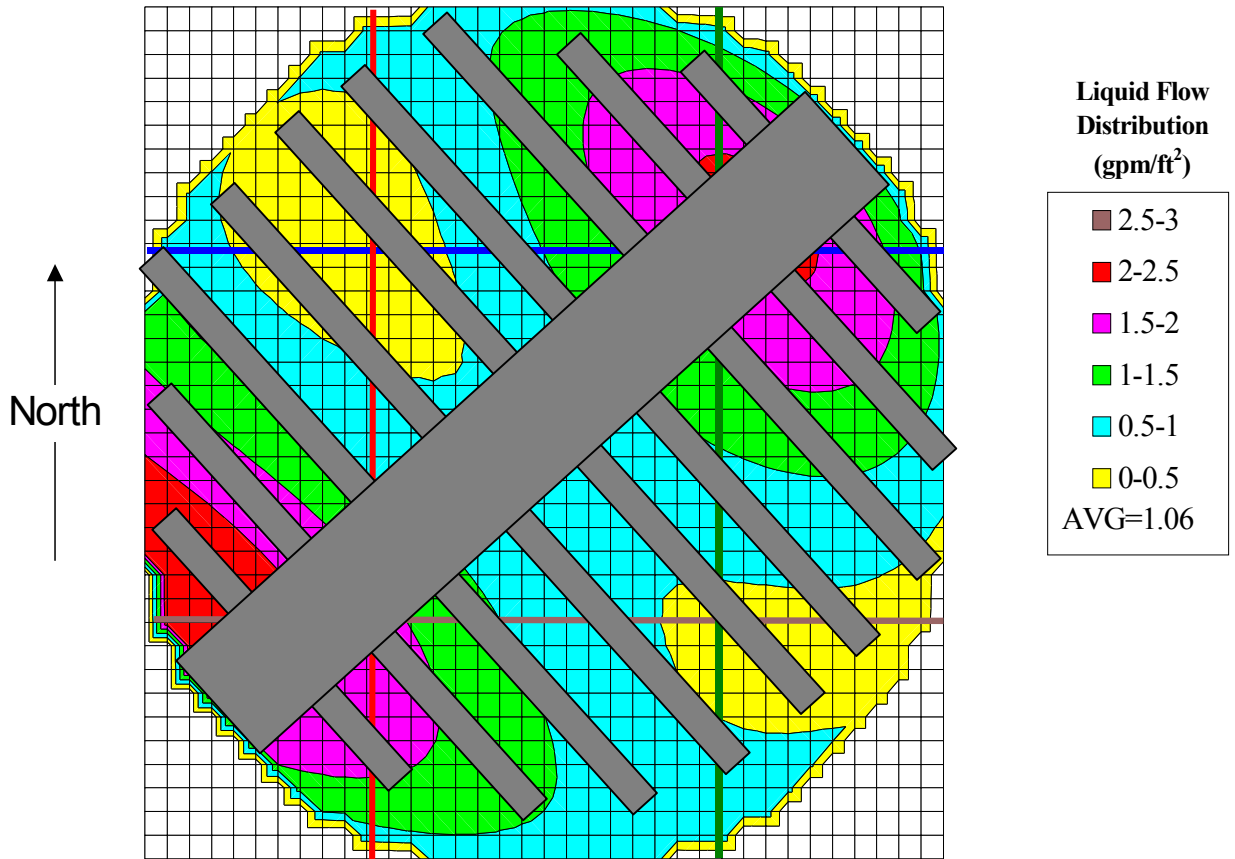
CAT-Scan Contour Plot
Good Distribution



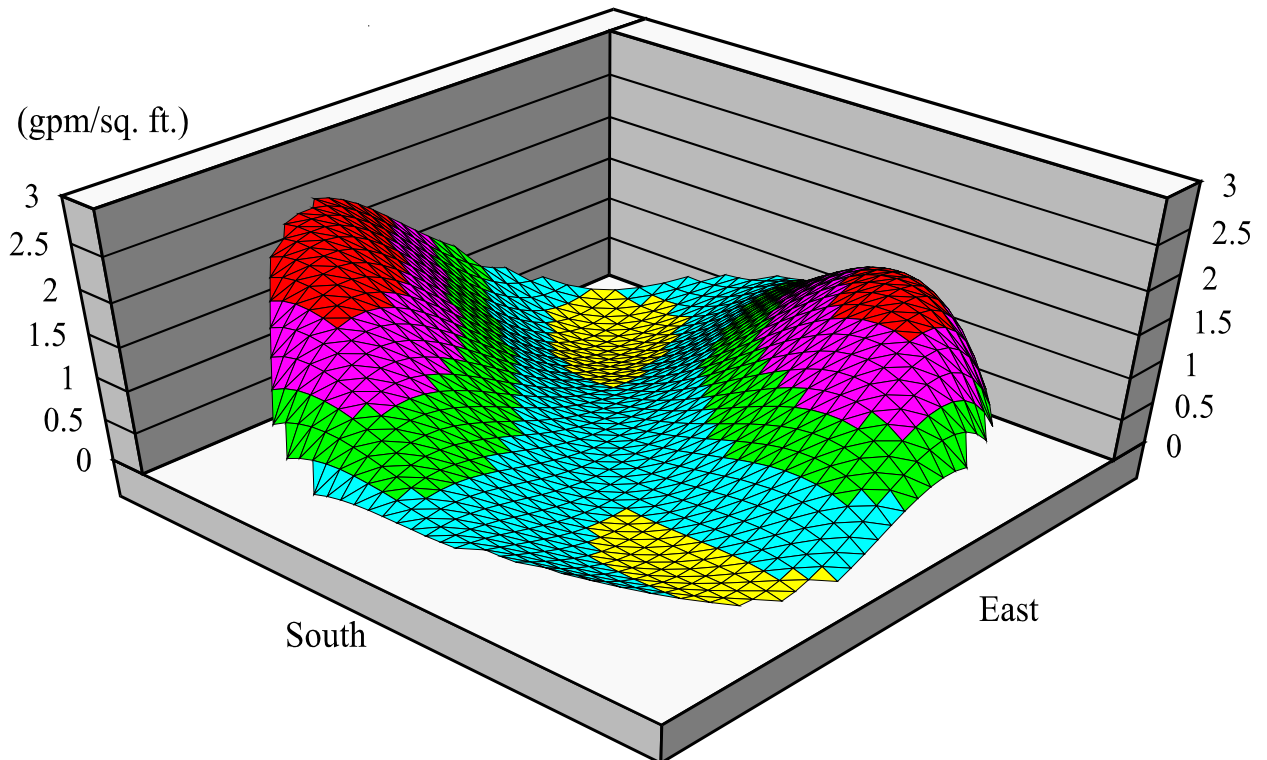
3-D Surface Plot



CAT-Scan Contour Plot
Poor Distribution



3-D Surface Plot





Critical Path **10' OD x 120' T/T** **Single Pass Trays**

- Safety Orientations - 28 men U\$S45/hr
- Supply/Install Isolation Blinds
- Clean Tower for Entry
- Open External Manway
- Erect Scaffold 6' from bottom tray
- Open & Tunnel internal manway's
- Sweep tray's
- Replace small amount of hardware
- Final inspection by client & contractor
- Close internals/tray manways
- Remove internal scaffolding
- De-blind column
- Close external manways
- De-mobilize

EQUIPMENT

- 2 - Trucks
- 1 - Tool Trailer
- 1 - 650 CFM Air Compressor
- 1 - Air Tugger
- 12 - Low Volt Lights
- 4 - Radios
- 1 - Lot Fresh Air Equipment

Duration 3.5 Days (includes mobilization and demobilization)
Manpower - 14 men per shift - work (2) elevations

Total Man Hours - 1,232

Total Cost - \$19.900

COST OF SCAN: < \$5,000
TIME REQUIRED: < 8 HOURS



Critical Path 10' OD x 120' T/T Replacement Single Pass Trays

Scheduled Costs

- (1) Single Pass Valve Tray 410 SS
Normal Rate Price: ~ \$8,000
Delivery Time - 4 Weeks

Emergency Costs

- (1) Single Pass Valve Tray 410 SS
Expedited Rate Price: ~ U\$S 59,660.00
Delivery Time - 24 Hrs Minimum

**COST OF SCAN: < \$5,000
TIME REQUIRED: < 8 HOURS**

Benefits of Pre-Turn-Around Scans

Mechanical Problem - Four Towers

Process Problems - Five Towers

No Problems Indicated - Ten Towers

(Entry can be eliminated if no history of fouling or corrosion)

Crude Unit

Atmospheric Tower

All trays in place

Vacuum Tower

LVGO distributor plugged or damaged

HVGO draw tray leaking or wash

oil distributor damaged

Crude Unit

Main Fractionator

Trays 21 and 22 damaged, all other internals in place

Alky Unit

Isostripper

High reflux rate or subcooled reflux causing
flooding on top four trays, lower
accumulator leaking

Depropanizer

Severe liquid entrainment throughout the
tower, no indications of mechanical damage

Acid stripper

No problems indicated

Acid regenerator

No problems indicated

Unsat Gas Plant

Isobutane Absorber

Flooding present on top 32 trays

Amine Absorber

No Problems Indicated

Debutanizer

No Problems Indicated

Depropanizer

No Problems Indicated

Naptha Splitter

No Problems Indicated

Sat Gas Plant

Stripper

No Problems Indicated

Amine Absorber

No Problems Indicated

Debutanizer

Severe flooding throughout the tower

Depropanizer Dryer

High reflux rate or subcooled reflux
flooding top three trays, Tray 10 heavily
loaded - possible downcomer restriction

Sponge Oil Absorber

No Problems Indicated

Main Absorber

All trays in place

Delayed Coking Unit

Coker Fractionator

No Problems Indicated

Saves Time

Most Efficient Use Of Engineers
And Other Skilled Positions

Saves Money

The Most Direct Approach Towards
Solving Online Problems

Increase Production

Optimize Online Production, Extended Run Times,
Minimize Unscheduled Downtimes

Avoid Surprises

Anticipate Problems Before They Reach
A Critical Point

Tru-Tec / Xycon-Flox S.A.

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