Power Delivery – Why It Matters

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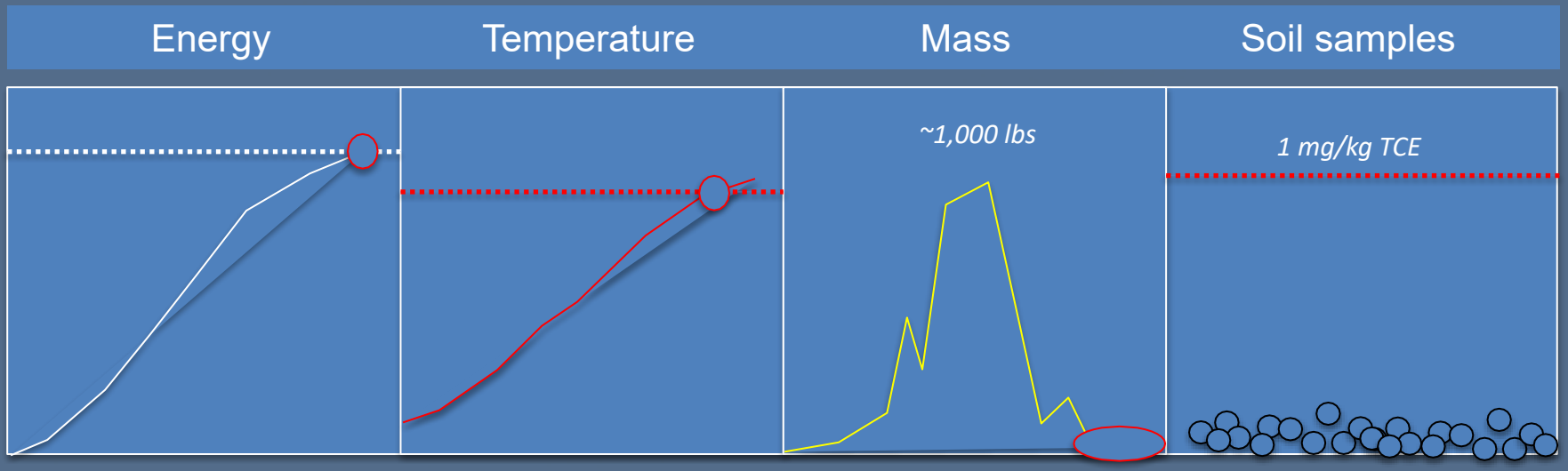
Session 5, Abstract 451

TRS Group

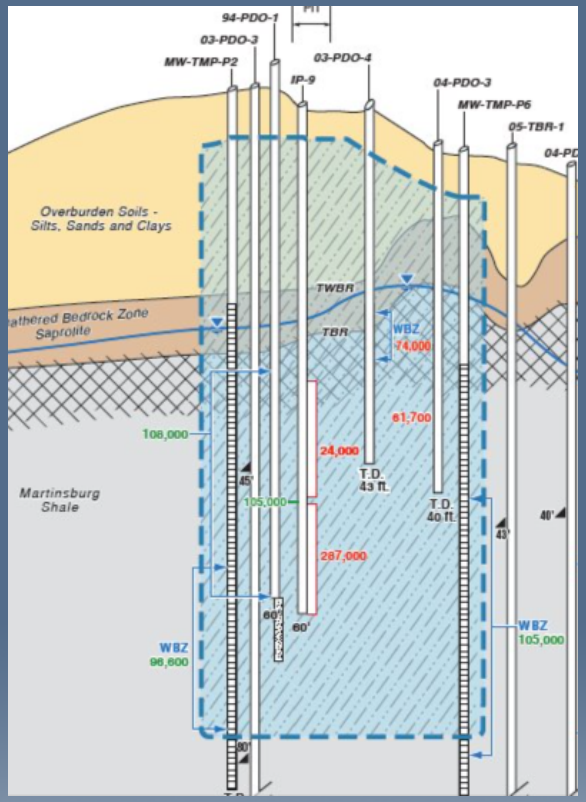
Are we done yet?

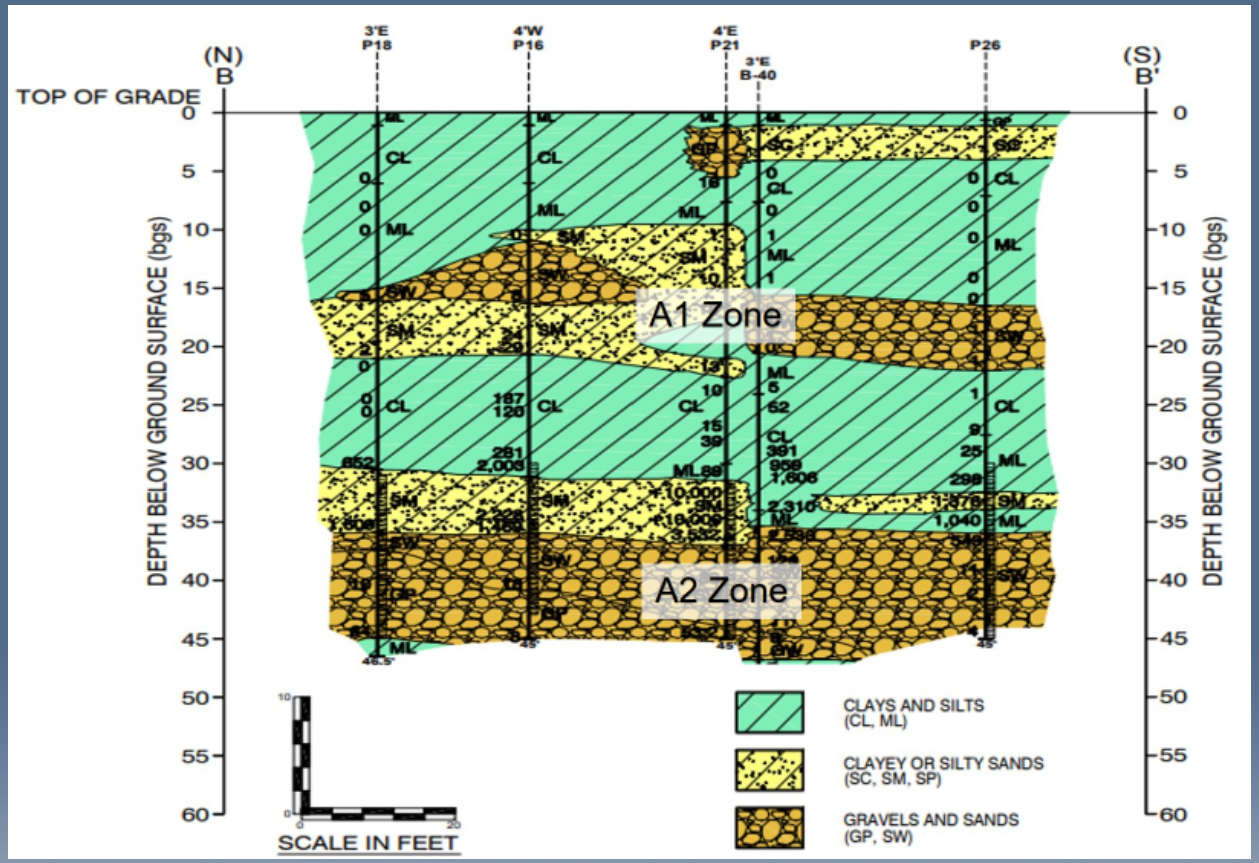


More power in: shorter operations time, lower energy usage

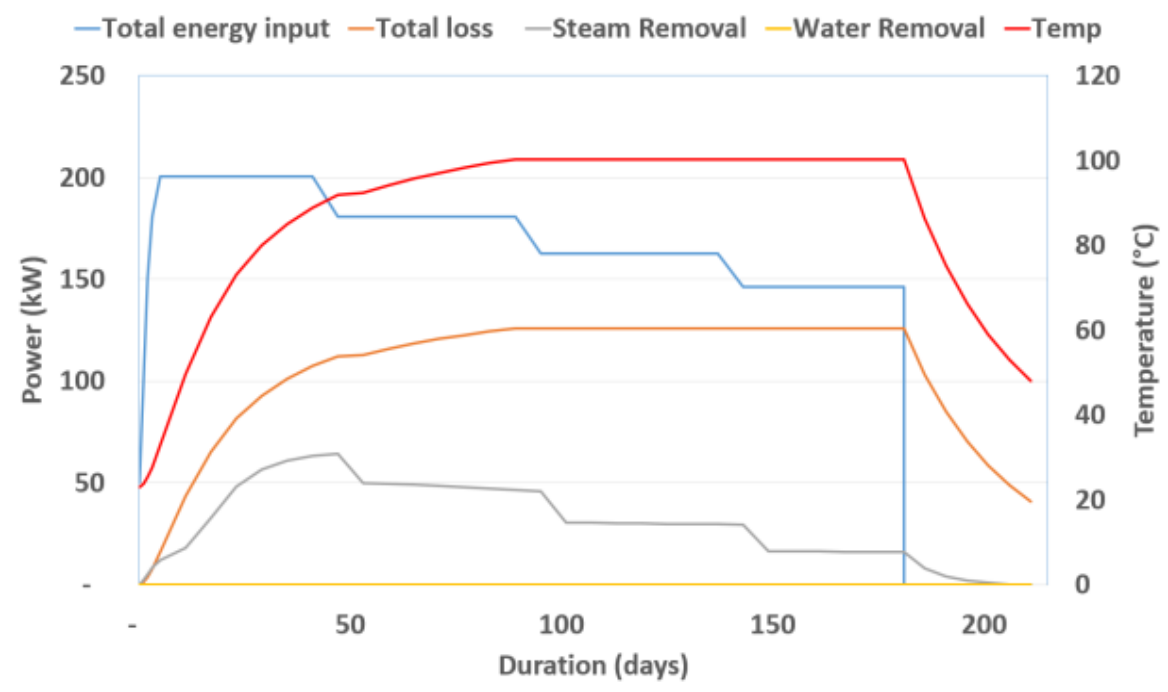
Cost and Environmental Impact

Conceptual Site Model





Thermal Model



Steaming energy

Density, heat losses

Energy removal

(steam, groundwater flow)

Fraction of organic carbon

Remedial objectives

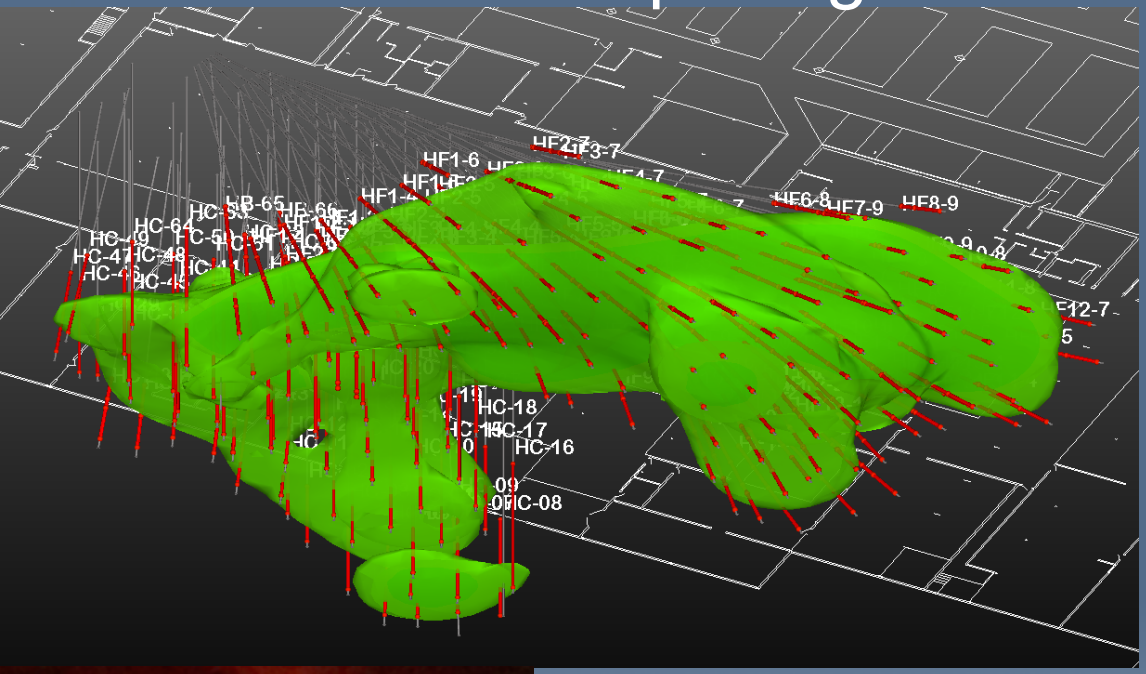
Power & Energy Density

$$Power\ Density = \frac{kilowatt}{vd^3}$$

$$nergy\ Density = \frac{kilowatt * ho}{vd^3}$$

TCH Design Considerations

Heater spacing

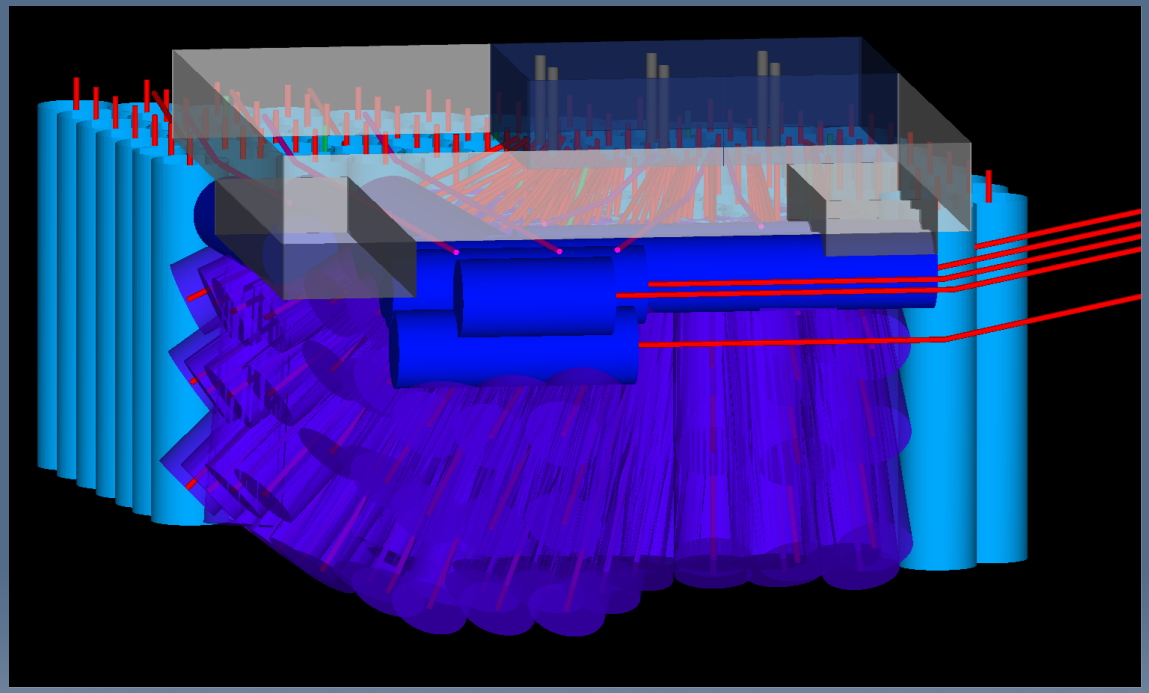


Heater design

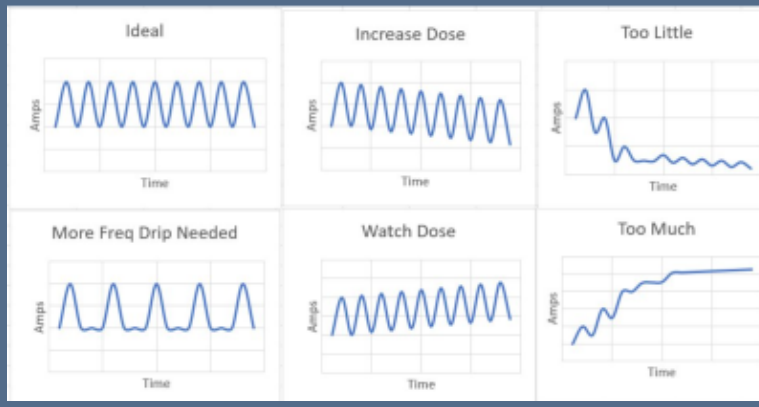
Voltage control

ERH Design Considerations

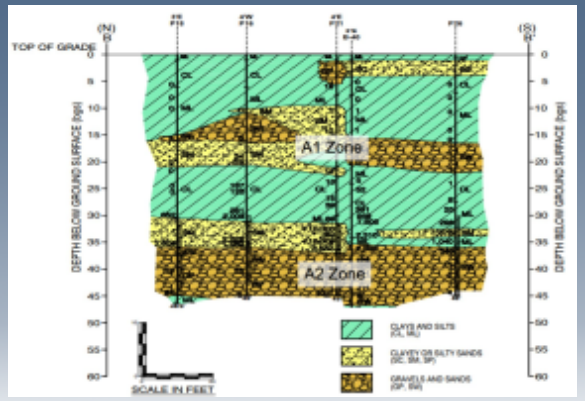
Electrode Spacing



Electrode Resistance Management



Formation Resistance Considerations



In situ Thermal Remediation Optimization

- ISTR: TCH and ERH
- ERH: using soil matrix as resistor (variable resistance)
- TCH: using alloys as resistor (fixed resistance)
- Key data collection: pre ops
- TCH: confirm heater construction and circuit resistance
- ERH: field testing to confirm bulk soil resistance
- Anticipated voltage determined

In situ Thermal Remediation Optimization

- Time to confirm design expectations
- Power and energy monitoring
  - Macro: utility and PCU meter readings
  - Micro: electrode, heater focused
- Key data collection in ops
  - TCH: casing temperature mapping, circuit amperage
  - ERH: electrode amperage

TCH Power Optimization

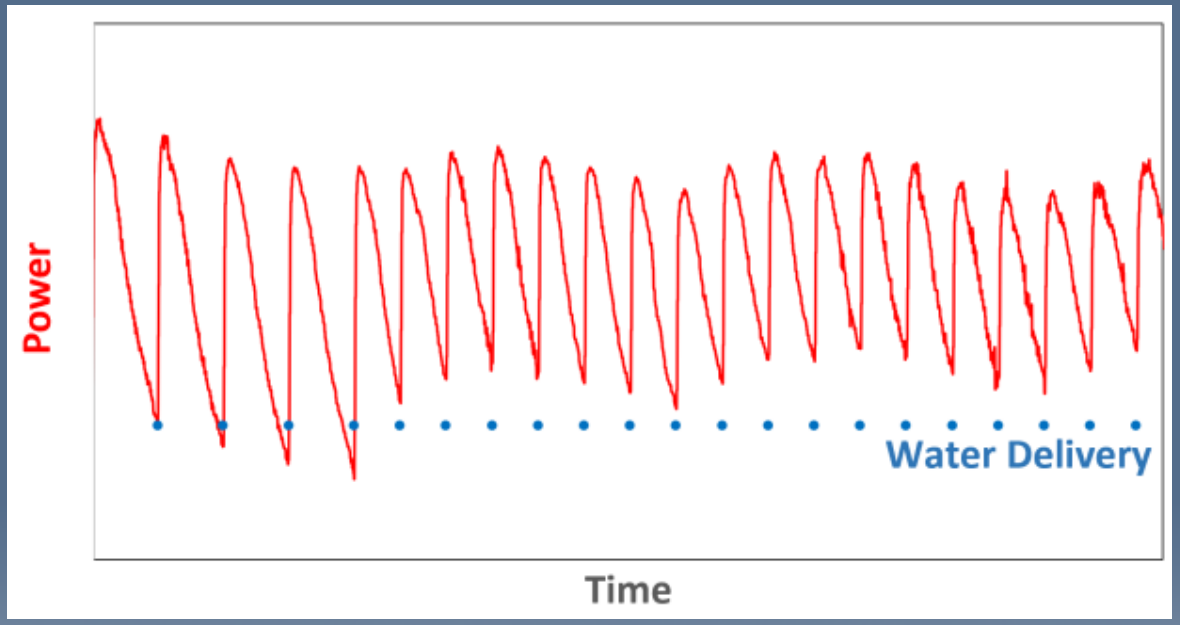
Circuit design – total resistance
Casing temperature mapping

Voltage adjustments
Circuit reconfiguration
Heater reconfiguration

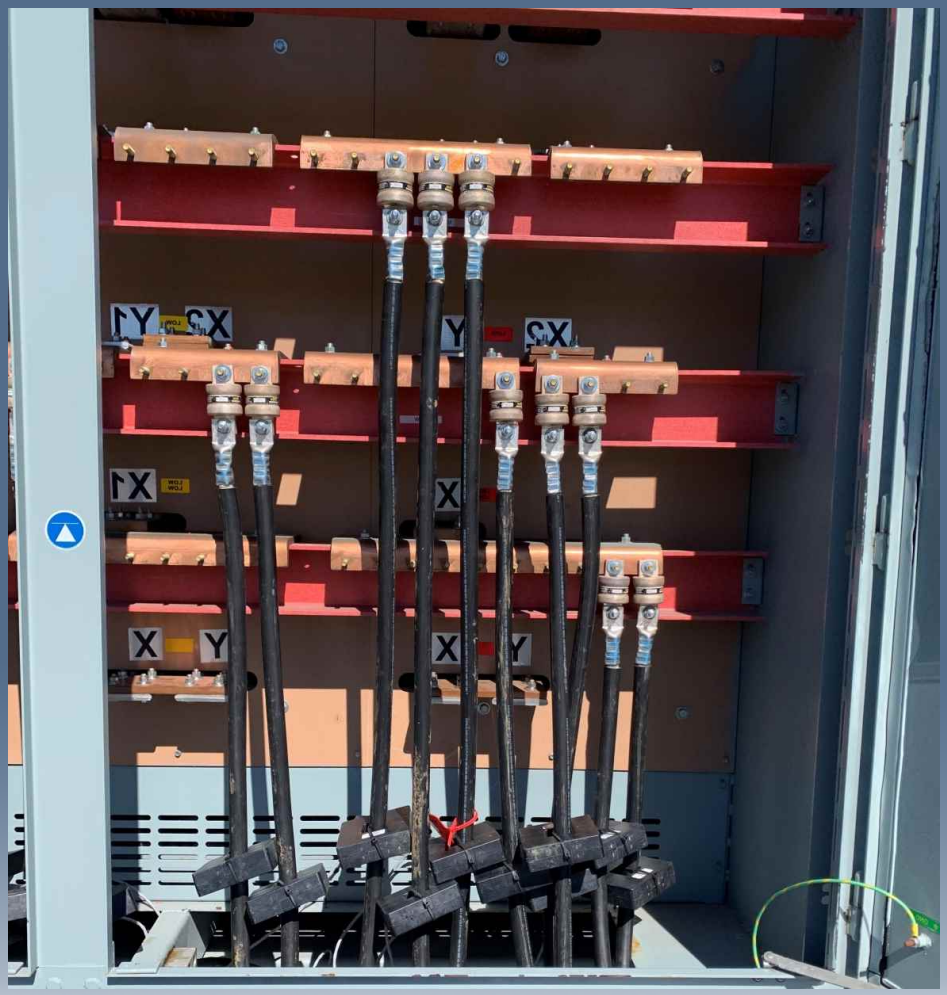
Voltage Control

ERH Power Optimization

- Bulk soil resistance changes with temperature
- Dictates strategy changes: moisture add or voltage change

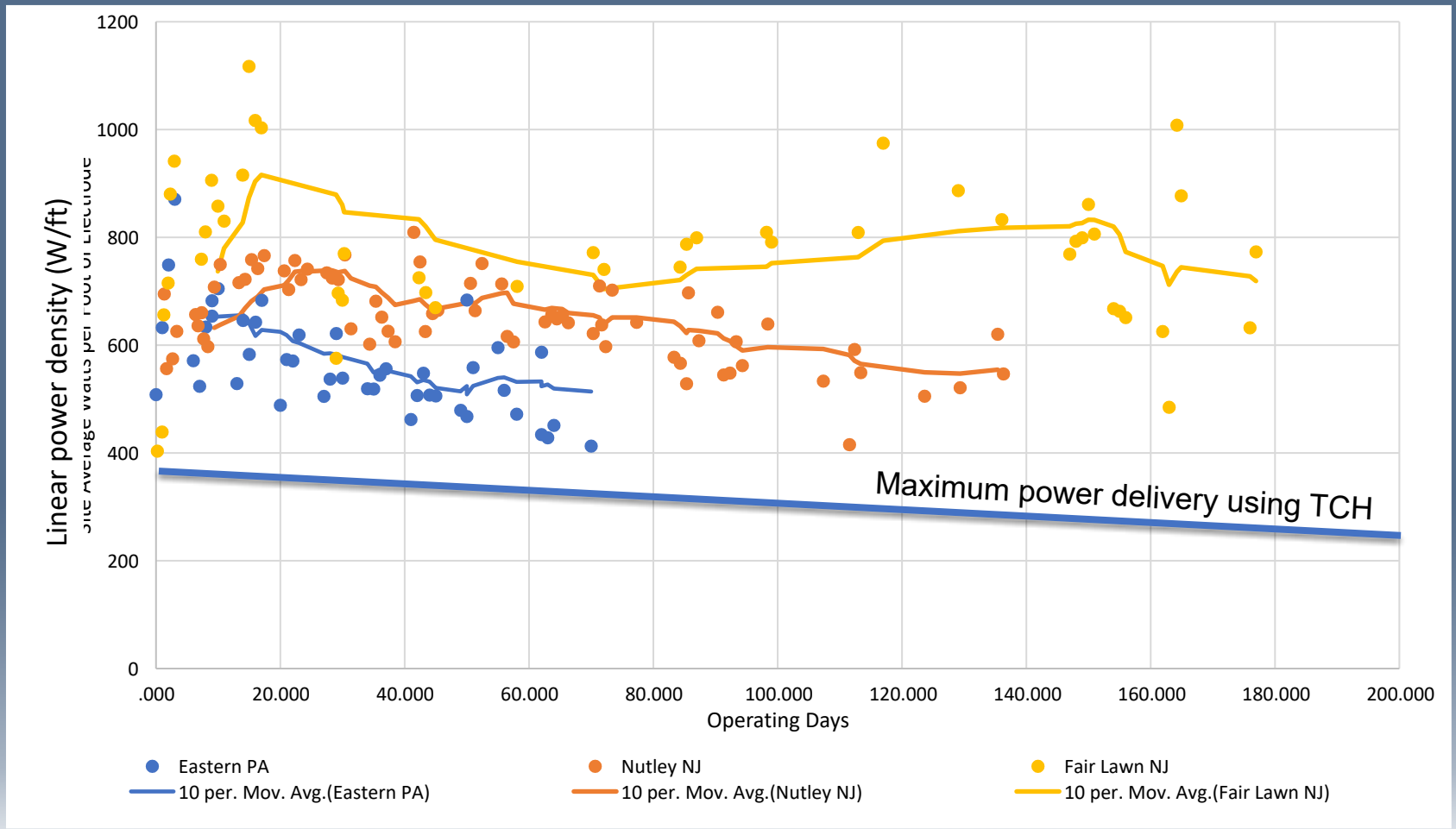


Voltage Management

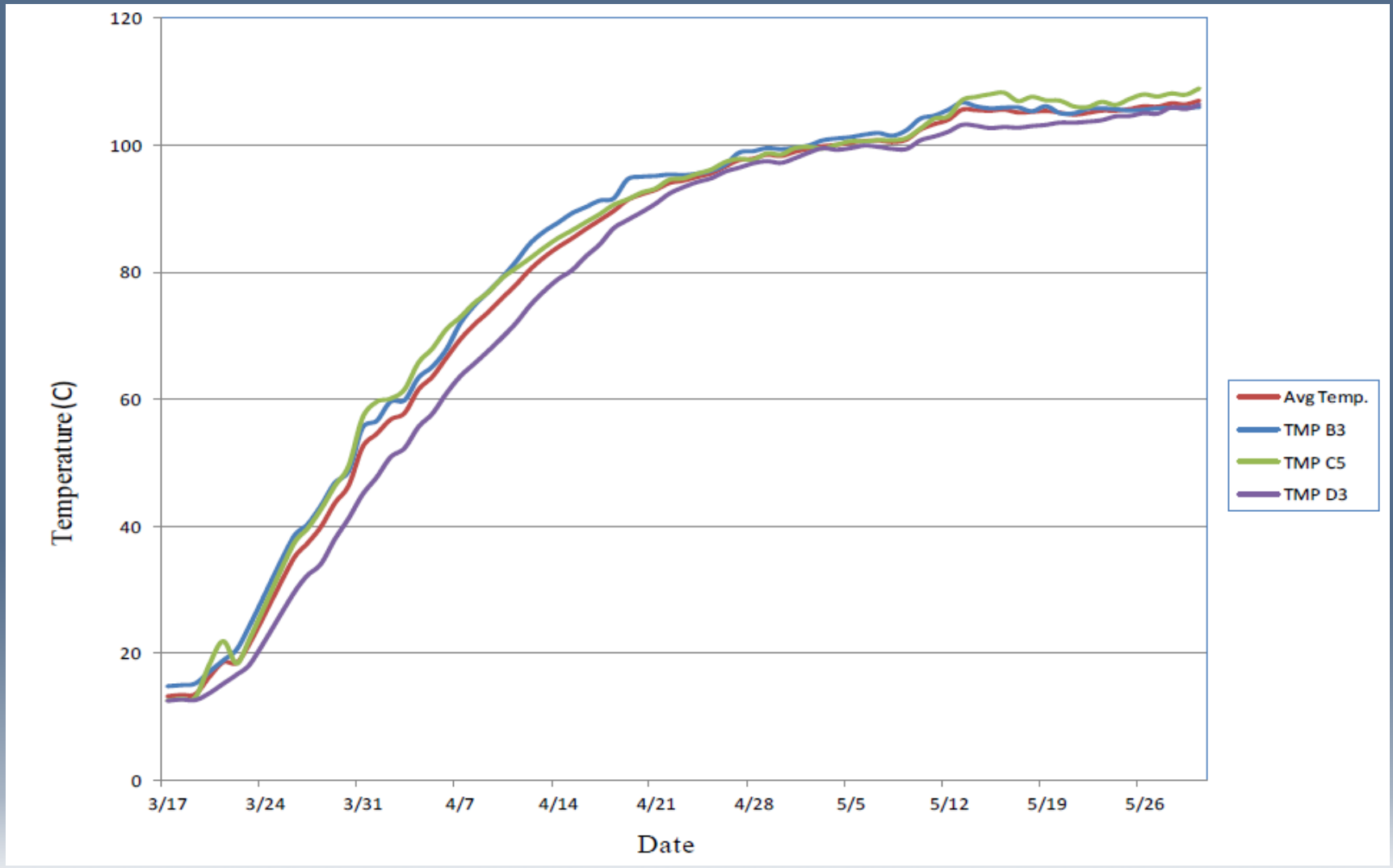


Tap switches, SCR and field transformers

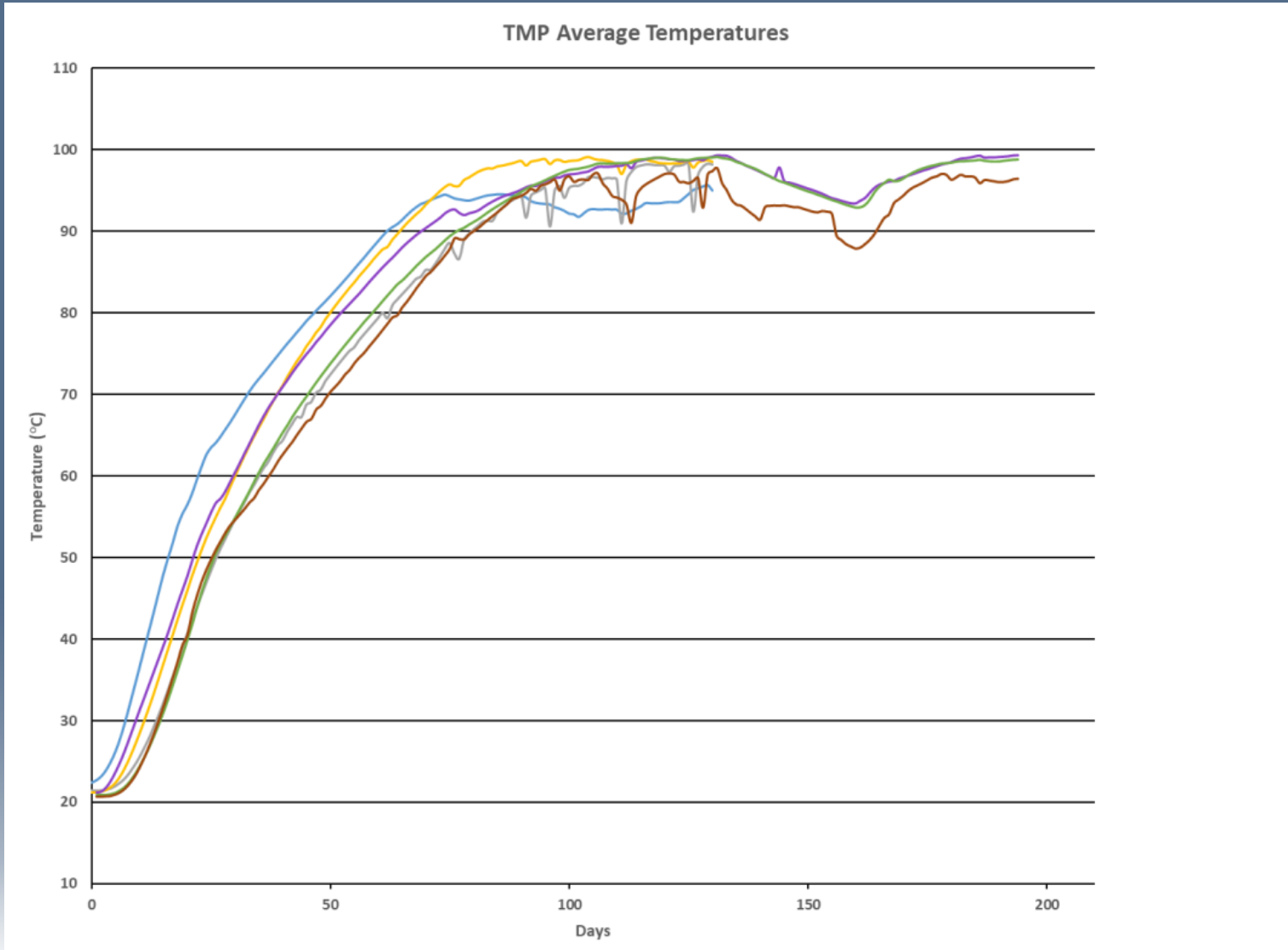
Linear Power Density Comparison



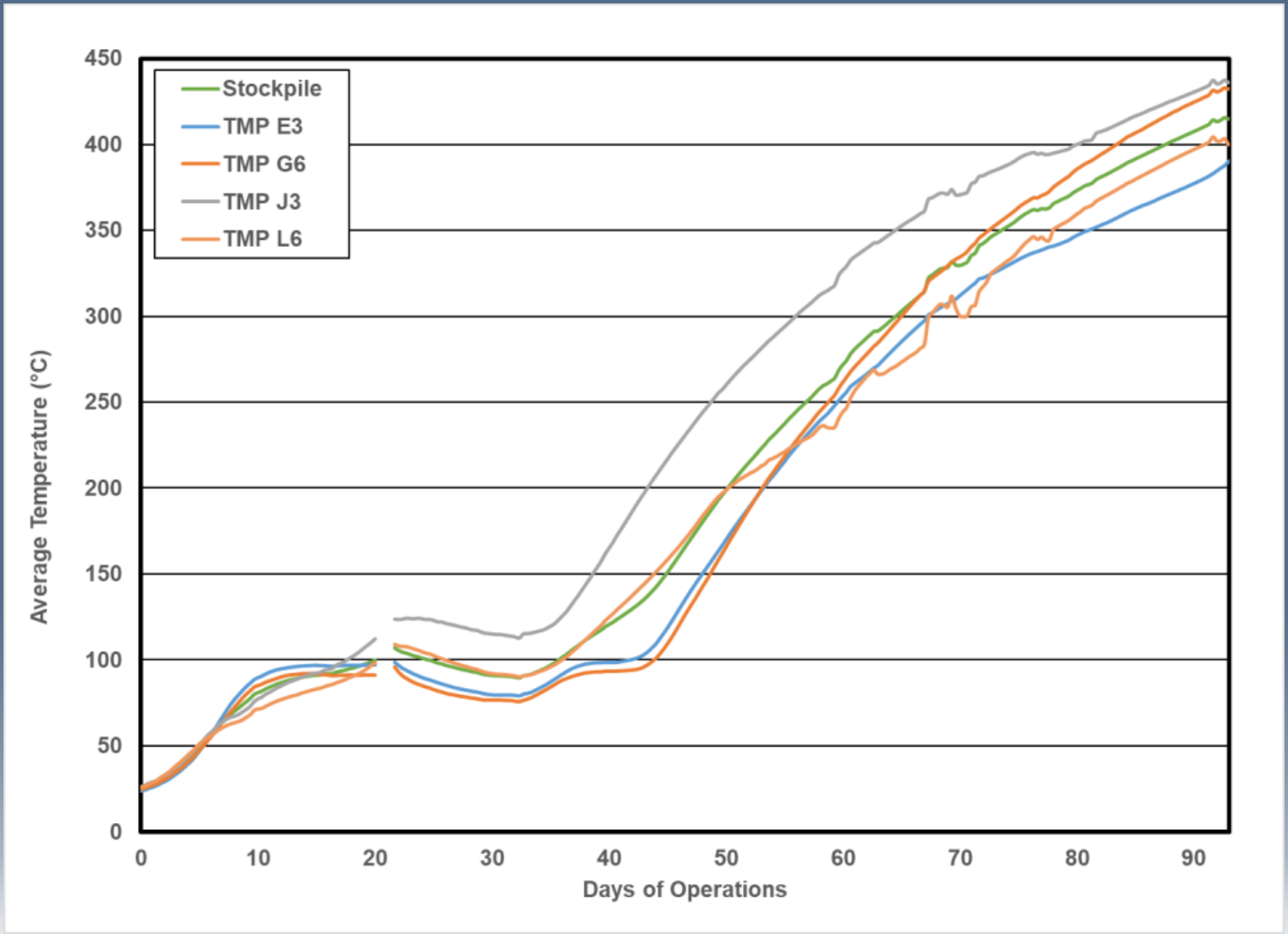
ERH Heat-up to Boiling in 60 days



TCH Heat-up to Boiling in 60 days



TCH Vadose Heat-up to Boiling in 20 days



Energy Cost Management

- Shallow heating: surface insulation
- Permeable sand lens: gentle upgradient pumping
- Demand management: can’t be careless

Conclusions

- Energy delivery management is key to cost effective ISTR
- Accurate conceptual site model required
- Thermal modelling and design
- Heat Loss management
- Specialized equipment required
- Monitoring of key operational parameters
- Routine review data

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