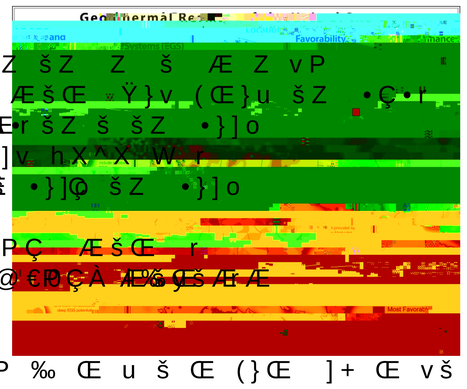


Specific Objectives

- Develop mathematical model to estimate heat extraction from closed-loop geothermal systems that are characterized by
  - Large aspect ratios, i.e., large length-to-diameter ratios, presenting challenges to numerical calculation
  - Time scale of years
  - Complex physical properties

Case Study: InnerGeo, U.S. Patent 8,991,488 B2

Table 1. Summary of Geometric and Operating Parameters

Geometry
- Well diameter: 17 in
- Injection tube: 8 in
- Production (heated water) tube: 3 in
- Heated tube section (horizontal): 5280

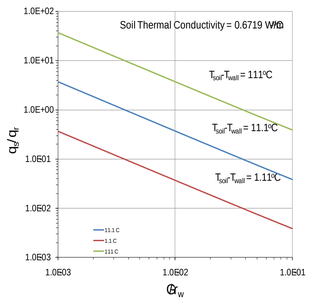
Operating condition
- Feed water: 200 F
- Production water: 350 F
- Flowrate: 1000 gallon/min

Quasi-Steady State Water-Side Heat Transfer

- Water-side heat transfer
  - Heat-load and overall heat transfer coefficient needed
    - $M_{\dot{q}}$ L é 3: $D_{\emptyset}$ F $D_{\emptyset}$ = 20.4MW$_{th}$
    - $7_{\dot{a}}$ L $M_{\dot{q}}$ (#¿6$_{3,\dot{a}}$) = 201.3W/m-^{o}C
- Tube heat transfer coefficient: water properties
  - 0 QL r ät u4 Á^{4*}2 N^{43}
  - $7_{\dot{a}}$ = 2,117*W/m-^{o}C* >> 201.3 *W/m-^{o}C*
- Water-side can deliver heat transfer needed

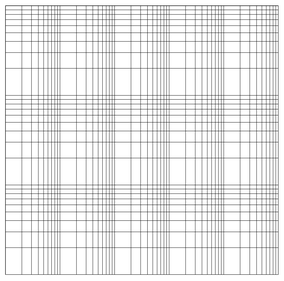
Quasi-Steady State Soil-Side Heat Transfer

- Soil-side
  - Heat transfer from soil to wall
    - $M_{\dot{q}}$ L t è .$G_{\dot{a}}$: $6_{\dot{a}}$F $6_{\dot{a}}$; Ž •N N ;
  - Thermal penetration length
    - *delta = r_p*



Line Source Analysis

Soil Temperature Requirements , š Z š À • X ^ À] o o _ W Œ }



‡^ À] o o _ ‰ Œ } µ š] } decreases with increasing heat rate extraction

heat rate extraction