TWO MAIN MINERAL PRECIPITATION PROBLEMS EXISTING AT THE ROOSEVELT HOT SPRINGS UNIT

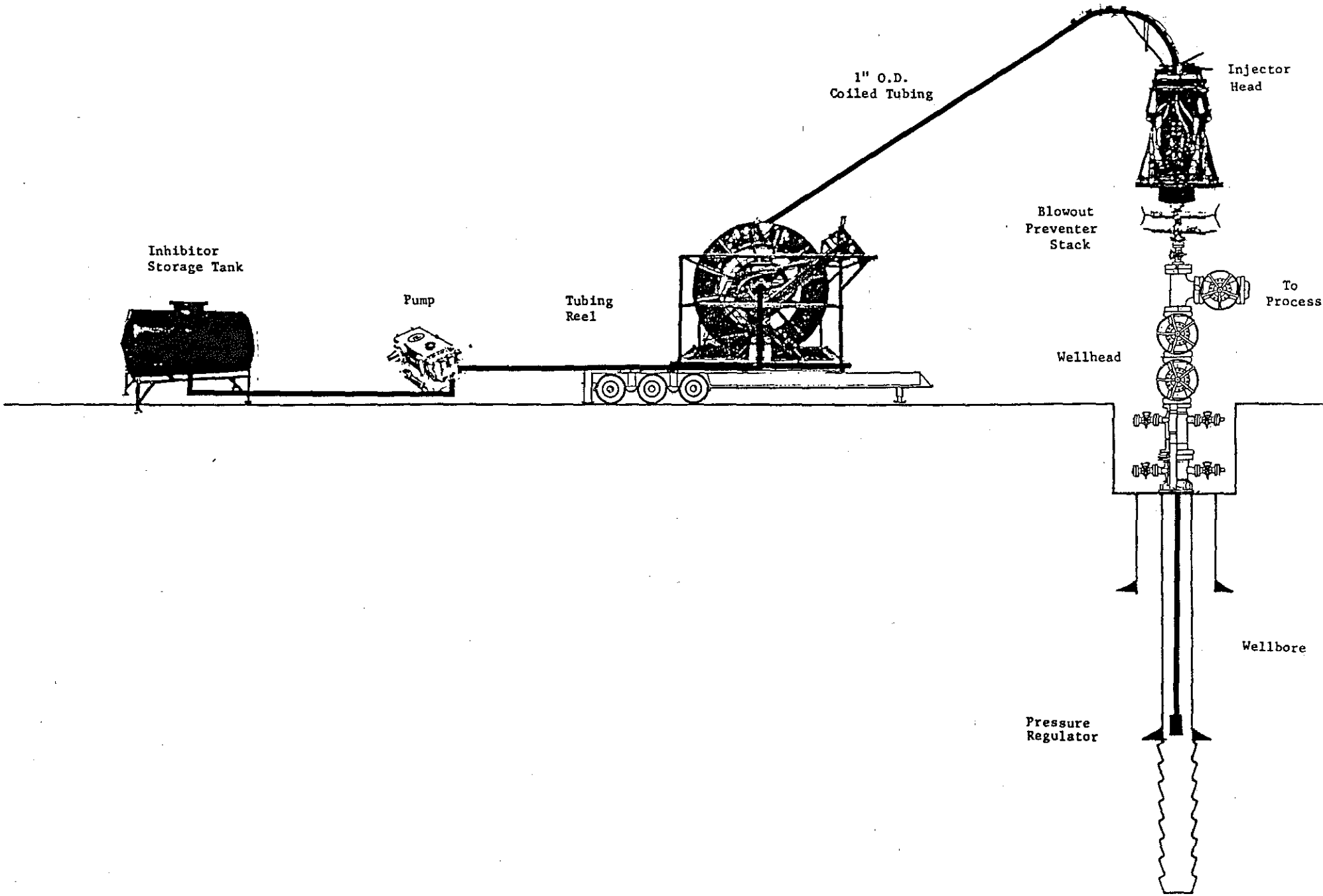
* CALCIUM CARBONATE--CACO3
  (WELLBORE)

* AMORPHOUS SILICA--SIO2
  (SURFACE FACILITIES)

MINERAL PRECIPITATION IN GEOTHERMAL DEVELOPMENT SYSTEMS IS ONE OF THE MOST INFLUENTIAL FACTORS IF NOT THE MOST INFLUENTIAL FACTOR AFFECTING PROJECT PROFITABILITY.

PHILLIPS PETROLEUM COMPANY

DOWNHOLE CHEMICAL ANTISCALANT INJECTION OPERATIONS



ADVANTAGES OF DOWNHOLE INHIBITOR INJECTION

* DECREASED WELL WORKOVERS
* LONGER CASING LIFE
* IMPROVED ECONOMICS
* CONTINIOUS DOWNHOLE PRESSURE IN FLOWING WELLS
* INCREASED PRODUCTION PER WELL
* ABILITY TO DEVELOP OTHER LESS ECONOMICAL RESOURCES
* INCREASED REVENUE GENERATED PER WELL

OPTIMISTIC ECONOMICS ON DOWNHOLE INJECTION

ACID JOBS EXPENSE	DOWNHOLE INJ INVEST	DOWNHOLE INJ EXPENSE	INVEST COST	EXPENSE SAVINGS
$850,000	600,000	100,000	600,000	750,000
850,000	0	100,000	0	750,000
850,000	0	100,000	0	750,000
850,000	0	100,000	0	750,000
850,000	0	115,000	0	735,000
850,000	0	100,000	0	750,000
850,000	0	100,000	0	750,000
850,000	0	100,000	0	750,000
850,000	0	100,000	0	750,000
850,000	0	115,000	0	735,000
850,000	0	100,000	0	750,000
850,000	0	100,000	0	750,000
850,000	0	100,000	0	750,000
850,000	0	100,000	0	750,000
850,000	0	115,000	0	735,000
850,000	0	100,000	0	750,000
850,000	0	100,000	0	750,000
850,000	0	100,000	0	750,000
850,000	0	100,000	0	750,000
850,000	0	115,000	0	735,000
850,000	0	100,000	0	750,000

PESSIMISTIC ECONOMICS ON DOWNHOLE INJECTION

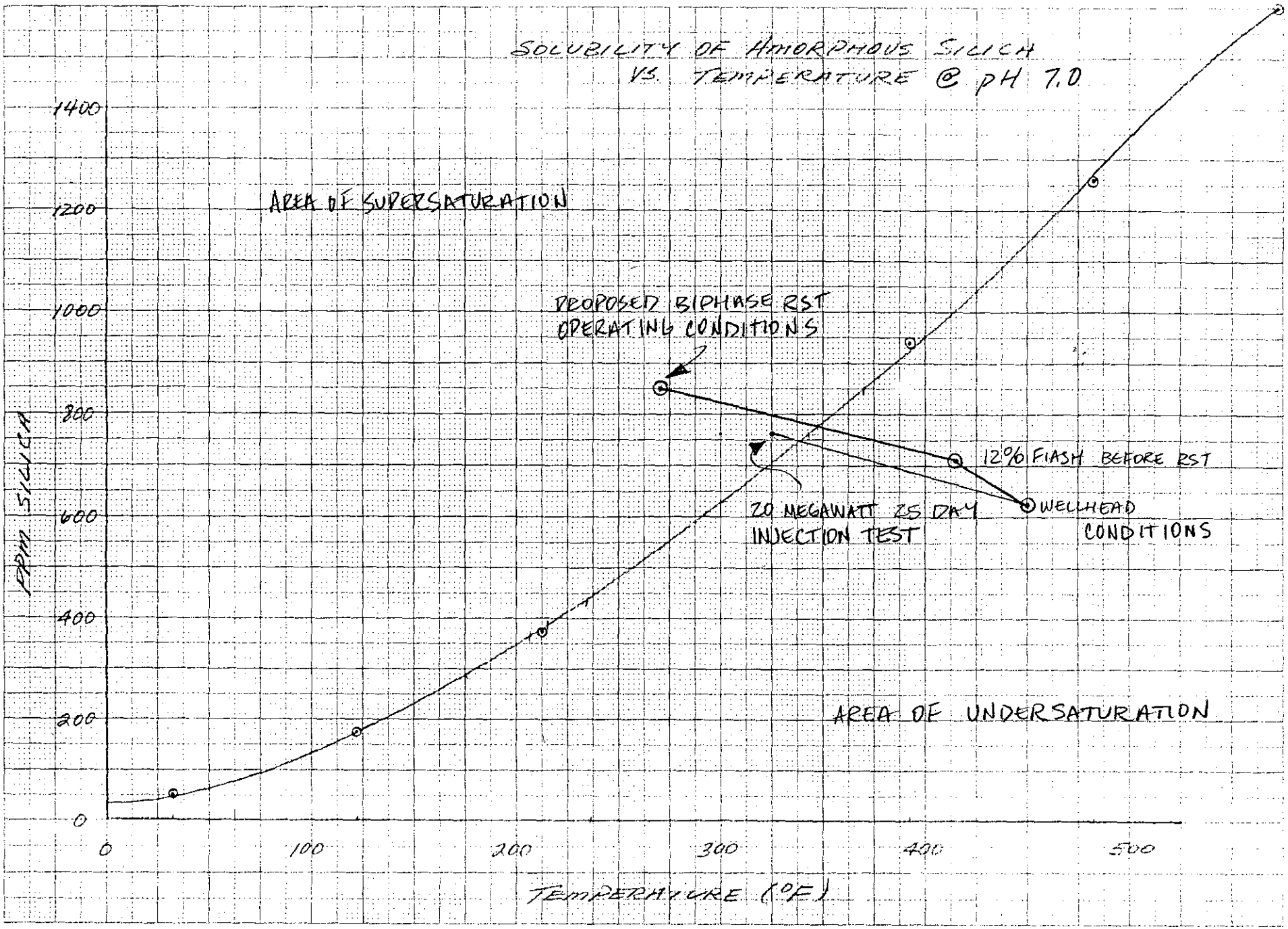
ACID JOBS EXPENSE	DOWNHOLE INJ INVEST	DOWNHOLE INJ EXPENSE	INVEST COST	EXPENSE SAVINGS
$600,000	600,000	250,000	600,000	350,000
600,000	0	250,000	0	350,000
600,000	0	250,000	0	350,000
600,000	0	250,000	0	350,000
600,000	0	265,000	0	335,000
600,000	0	250,000	0	350,000
600,000	0	250,000	0	350,000
600,000	0	250,000	0	350,000
600,000	0	250,000	0	350,000
600,000	0	265,000	0	335,000
600,000	0	250,000	0	350,000
600,000	0	250,000	0	350,000
600,000	0	250,000	0	350,000
600,000	0	250,000	0	350,000
600,000	0	265,000	0	335,000
600,000	0	250,000	0	350,000
600,000	0	250,000	0	350,000
600,000	0	250,000	0	350,000
600,000	0	250,000	0	350,000
600,000	0	265,000	0	335,000

RESEARCH AND DEVELOPMENT COSTS FOR DOWNHOLE INJECTION TESTS

PHILLIPS PETROLEUM COMPANY	$167,000
AMAX EXPLORATION, INC	19,300
THERMAL POWER COMPANY	19,300
O'BRIEN RESOURCES	18,000
GEOTHERMAL POWER CORP	1,400
GRAYWES RESOURCES, INC	1,400
VTN CONSOLIDATED, INC	1,200
	$227,600

WHAT TESTS NEED TO CONDUCTED AT RHSU?

* FORMATION PLUGGING ANALYSIS
* TEMPERATURE VS. PRECIPITATION
* KINETICS OF REACTION MECHANISMS
* INHIBITOR TESTING


SOLUBILITY OF AMORPHOUS SILICA
VS. TEMPERATURE @ pH 7.0
AREA OF SUPERSATURATION
PROPOSED BIPHASE RST
OPERATING CONDITIONS
12% FLASH BEFORE RST
WELLHEAD
CONDITIONS
20 MEGAWATT 25 DAY
INJECTION TEST
AREA OF UNDERSATURATION
PPM SILICA
1400
1200
1000
800
600
400
200
0
0
100
200
300
400
500
TEMPERATURE (°F)

SILICA DEPOSITION PROCESS FLOWSHEET