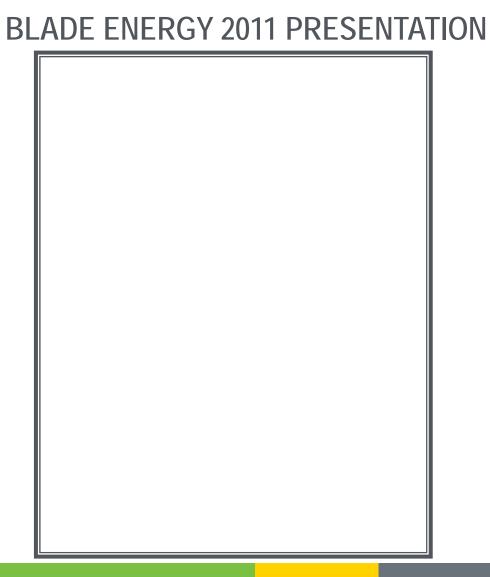
SMU GEOTHERMAL LAB CONFERENCE GEOTHERMAL ENERGY AND WASTE HEAT TO
POWER: UTILIZING OIL & GAS P

BLADE ENERGY 2011 SMU & GRC PRESENTATIONS

- ANNULAR CIRCULATION
 CO-PRODUCTION (ACC) SYSTEM
- TRANSFER HEAT FROM
 PRODUCTION STREAM TO
 WORKING FLUID IN WELLBORE
- USE WORKING FLUID VAPOR TO GENERATE POWER ON SURFACE

Suryanarayana, Sachdeva, Ceyhan, Ring, Blade Energy Partners, (2011), System Design Alternatives and their Influence on Geothermal Heat Recovery from Co-Produced Oil and Gas Wells, GRC Transactions, Vol. 35





HISTORY OF GRAVITY HEAD ENERGY SYSTEM

- GEOTHERMAL POWER SYSTEM
- WF DRIVES EXPANDER, WHICH DRIVES PUMP
- PROTOTYPE DEVELOPED WITH DOE



GRAVITY HEAD PUMPS

- How does it work?
- Requires one more internal string
- MINIMAL ADJUSTMENTS TO THE WELLHEAD
- EXPANDER-PUMP ROTATES AT HIGH SPEED
- No moving parts at surface
- CAPABLE OF REMOTE OPERATION

GRAVITY HEAD PUMPS

- CAN INSTALL DEEPER THAN SHAFT-DRIVEN PUMP
- ELIMINATES POWER SOURCE AND CABLES NEEDED FOR ESP
 - HIGHER ALLOWABLE OPERATING TEMPERATURE
- INHERENTLY CLEAN WORKING FLUID RUNNING EXPANDER
- Pump can be retrieved & installed by wire line to minimize downtime & reduce costs

GRAVITY HEAD PUMP APPLICATIONS

- Many oil wells today have a high water cut
- THOUSANDS OF OIL/WATER WELLS CAN USE THIS PUMPING SYSTEM TO ELIMINATE NEED FOR POWER
- HUNDREDS OF LINE SHAFT AND SUBMERSIBLE GEOTHERMAL PUMPS CAN BE REPLACED DUE TO CAPEX AND OPEX
- APPLICABLE FOR ON/OFFSHORE LOCATIONS

GRAVITY HEAD PUMPS - CONCEPT TO COMMERCIALIZATION

- POTENTIAL MARKET
 - ENHANCE HYDROCARBON PRODUCTION IN HIGH WATER CUT WELLS
 - GENERATE POWER FROM WATERED OUT WELLS
- ESTIMATE # OF WELLS BY STATE
- COMPETING TECHNOLOGIES
- FABRICATION COSTS
- Power production (if included)

GRAVITY HEAD SYNERGIES

- SHARES BASIC ELEMENTS OF DEVELOPED TECHNOLOGIES
- GHES IN DEVELOPMENT FOR SEVERAL YEARS
 - Major elements designed & production ready
- SOPHISTICATED NUMERICAL MODELS FOR GHES AND ACC DEVELOPED AND TESTED MULTIPLE TIMES
- EXPERIENCED TEAM PREPARED TO IMPLEMENT GHP