VIABILITY OF USING WELLHEAD POWER PLANTS TO ACCELERATE GEOTHERMAL DEVELOPMENT IN KENYA

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Green Energy for Kenya

Outline

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Introduction….

- Kenya has prioritised geothermal for its power generation.
- GoK aspires to generate 5000 MW of electricity from geothermal sources by 2030
- In October 2015, Kenya's geothermal power plants dispatched 400 GWh (approx. 51%)
- As at May 2016, geothermal installed capacity was 632MW (27.5% of total installed electricity generation of 2,341 MW).

Introduction

Kenya's initiatives to accelerate geothermal development

- ✓ **Government support**:
  - Policy e.g. FiT. and PPP frame work
  - financing early resource exploration
  - Building in-country capacity (personnel & equipment)
- ✓ **Institutional Framework:** Unbundled and Specialized energy sub sector

Despite the institutional, financial, legal and regulatory frame work, the pace of geothermal power development is still slow

Early generation techniques

Photo: Olkaria Wellpad

There is need to adopt technological measures

Kenya has adopted early generation techniques by use of well-head generators.

Early generation techniques…

Kenya's Wellheads Experience

- 12 wellhead plants installed at the Olkaria geothermal field with a capacity of 65MWe (approx. 10% of total geothermal capacity)
- A further 120MW of installed wellheads capacities are planned and scheduled for commissioning by 2017.
- There is a growing interest from generators for further investment in more units to leverage on time and revenue

Early generation techniques…

Wellheads	
Merits	**Impact**
Easy deployment	Boosts electricity supply: more access
	Early revenue generation (time value of money)
	Eases financing dependence
Displace diesel (drilling)	Reduced project costs
Portability	Easily be moved to new and other geothermal areas
Standardized design and construction	Highly reliable
Long term testing of fields (green)	Increases private sector investor confidence

Early generation techniques...

Wellheads	
Demerits	**Impact**
Problems with distribution operation	Grid connection requirements
Difficulty in make-up well allocation	Extra cost for drilling
Low efficiency relative to large conventional plants	inability to enjoy the benefits of economies of scale

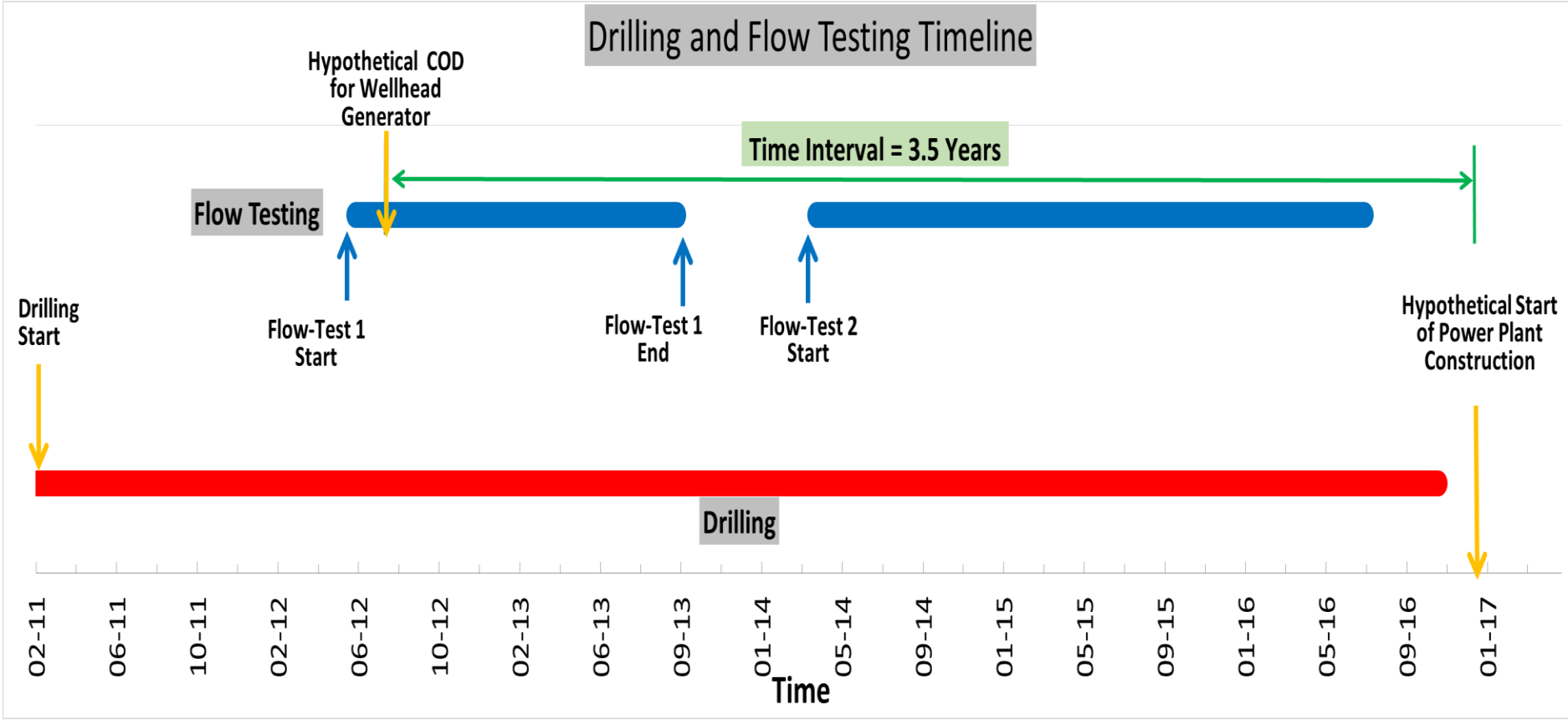
Wellhead has been successfully deployed at Olkaria geothermal field (which is a mature field or **BROWNFIELD**).

There is need to plan and deploy wellhead generators in other geothermal fields or **GREENFIELDS** e.g. Menengai

Menengai Project Overview….

- **Resource risks** have been reduced - accelerated drilling program and proving of commercial amount of steam.
- **Resource** identified – high temperature, high enthalpy, two-phase, 1st exploration well 2011 (MW-01)
- **Steam quality** range of approx. 0.3 – 0.9, more suitable for single flash plant
- **Number of wells** by October 2015 – 30 wells completed.
- Within the same period flow tests performed on several wells.
- The central power plants construction process expected to commenced end of 2016

Menengai Project Overview....



If the steam was used as early as it was proven, the project could have been earning revenue progressively

Hypothetical Wellhead Timelines

- ✓ Time interval (TI) determined from the first episode of flow testing to COD of central plant.
- ✓ TI = 3.5 years. Construction of central power plant assumed to commence in December 2016 and take 2 yrs.
- ✓ Total time interval (TTI) until the commercial operation date (COD) of the central power plant TTI = 5.5 years.
- ✓ A hypothetical single flash wellhead power plant of size 5MW was considered

Methodology

- This study focused on duration between field development and power plant construction phases of the project (COD)
- The time interval (TTI) was used to determine the viability of installing wellhead power plant before the commissioning of central plant, and over the WHU economic life
- Financial and economics of 5MW WHU over TTI was carried out.
- Profitability assessment models were applied (NPV, IRR and FCF)

5MW WHU assumptions

Technical Assumptions	Value	Unit
Wellhead power plant capacity	5	MW
Plant Economic life	20	Years
Number of operation hours	8768	h/y
Plant steam Consumption	8	t/hr/MW
Electricity Costs (Feed in tariff)	8.8	US Cents kWh
Capacity factor	95	%
Wellhead procurement Start date	June 2012	Date
Wellhead Commercial Operation Date (COD)	July 2013	Date
Conventional Plant construction start date	Dec 2016	Date
Conventional Plant Commercial Operation Date (COD)	Dec 2018	Date

5MW WHU assumptions

Costing Assumptions	Value	Unit
Capital Costs		
Power Plant Capital Cost	2.5	MUSD/MW
Indirect Power Plant Costs:		
Evacuation Facilities	0.5	MUSD
General Contingency – 2.5%	0.4	MUSD
Tax Contingency – 5%	0.8	MUSD
Operation & Maintenance costs		
Fixed O&M	0.5	MUSD/yr
Financing		
Repayment period	10	years
Months per year	12	months
Interest rate of loan	8	%
Local taxes	30	%
Equity/Debt ratio	70:30	%
Total Time Interval	5.5	Years

Results

- Total Capitals costs for 5MW WHU - $15 million.
- Projected net revenue:
  - ❑ $7 million - First 5.5 years
  - ❑ $32 million in its economic life (20 years).
  - ❑ NPV and IRR NPV Net Cash Flow turns +ve in 5th Year

WELLHEAD REVENUE ANALYSIS	TTI (5.5 Yrs)	ECONOMIC LIFE (20 Yrs)	UNIT
Net Cash flow	6.3	32	MUSD
NPV Total Cash Flow (Project)	-5	4	
IRR Total Cash Flow (Project)	-3	17	%
NPV Net Cash Flow (Equity)	0	3	
IRR Net Cash Flow (Equity)	17	35	%
Discounting Rate (MARR) Total – target rate	12.	12.	%
Discounting Rate (MARR) Equity– target rate	18	18	%

Results

Decision	TTI (5.5 Yrs)		ECONOMIC LIFE (20 YRS)	
	Measure	Decision Rule	Measure	Decision Rule
Project IRR vs. Project MARR	-3%<12%	Not Viable	17%>12%	Viable
Equity IRR vs. Equity MARR	17%<18%	Not Viable	35%>18%	Viable
Project NPV	-5	Not Viable	+4	Viable
Equity NPV	0	-	+3	Viable

Conclusion

Technical, financial and economics assessment of a 5MW well head generation unit is viable project if deployment is a long term strategy

Installation of wellhead generation is the best solution for realizing early revenue needs.

Thank You

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