

Municipal & Public Services:
Energy Efficiency Solutions to Achieve
Scale

8th March 2019



Shakti Pumps India Limited

Brief Company Profile



Established in 1982. Listed in **BSE & NSE India** in year **1995**.

750+ products performing over **52 unique applications** across **15 sectors** in **125+ countries**, made in **1 manufacturing unit** with an annual production capacity of **1 million pumps** with a turnover close to **100 million USD** for **SHAKTI GROUP** of Industries.



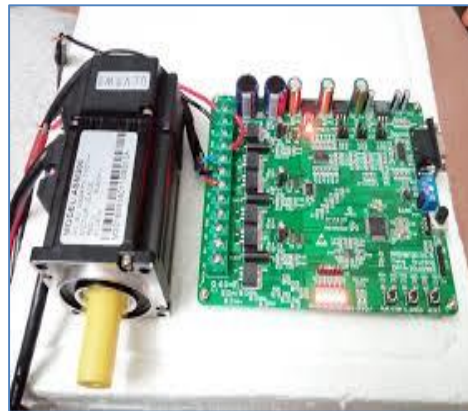
Shakti Pumps : Innovation

S4RM Technology



Induction Motor

+



PMSM Motor



Hybrid Motor

**S4RM: Shakti
Slip Start
Synchronous
Run Motor**

Patented Technology

S4RM: Shakti Slip Start Synchronous Run Motor



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Shakti Slip Start Synchronous Run Motor

Brief Information About the Innovation

- High efficiency (Unique combination of Induction and PMSM Motor)
- Power factor close to unity. (Unique)
- A PMSM machine without VFD.
- Reduced starting current and higher starting torque.
- High and constant discharge even at low voltage.



Surface Motor



Submersible Motor



Shakti Pumps : Innovation

Shakti Slip Start Synchronous Run Motor : Patents

Certifications/ Patents/ IPR

Indian Patent Application No.201721007519 A

“ HIGH STARTING TORQUE DIRECT LINE OPERATEDENERGY EFFICIENT MOTOR”

US Patent Application No. : US 20180254689A1

“ HIGH STARTING TORQUE DIRECT LINE OPERATEDENERGY EFFICIENT MOTOR” published on 6th Sept. 2018.



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Innovation Explanation and Technical Aspects

- The S4RM technology based motors are magnetic motors which are line start i.e. they do not require any VFDs to operate.
- The motor when coupled with pumps, provides high discharge even when the input voltage from the grid is lower because of synchronous operation.
- As it has magnetic rotor based motor, the runtime efficiency of the S4RM motor is 5-10% higher than that of an Induction Motor with lesser full load current
- The S4RM takes lesser starting current up to 50% as compared to other motors, thus offers a long life of motor insulation and lesser heat generation
- Power factor is close to 1, which is better for utility as they can serve more customer with exiting resource.



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Comparison With Existing Technologies

SL. No.	Parameter	Induction Motor	S4RM Motor	Implication
1	System Efficiency	Low	High	Energy Saving
2	Starting Current	7 to 8 times FL	4 to 5 times FL	Lower load on existing line
3	Full Load Current	High	Lower	Existing line can be used for more no. of loads
4	Power Factor	Lower (0.75-0.82)	High (close to 1)	Better utilization of existing resources
5	VFD required	No	No	Less no. of components in the system
6	Discharge with Voltage Variation	Variable	Constant	High discharge even at low voltage
7	Initial Cost Implementation	Lower	Little higher	No big investment from customer for new motors.
8	Reliability	High	High	Higher because of less heat
9	RPM	2750-2850	**3000	**Fixed RPM



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Efficiency & Cost Savings of S4RM: Surface Motor

SL. NO	POWER [KW]	S4RM Standard Efficiency [%]	IE-2 Standard Efficiency [%]	IE-3 Standard Efficiency [%]	IE-4 Standard Efficiency [%]
1	3	90.4	84.6	87.1	89.1
2	4	90.9	85.8	88.1	90
3	5.5	91.0	87.0	89.2	90.9
4	7.5	91.5	88.1	90.1	91.7
5	11	91.0	89.4	91.2	92.6



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Efficiency & Cost Savings of S4RM: Surface Motor

EXAMPLE	ENERGY SAVINGS & COST IMPLEMENTATION FOR 7.5 KW S4RM MOTOR	
INPUT POWER with IE2 Motor (kW)	$(O/P \text{ kW} / \text{IE2 EFF}) * 100$	$(7.5 / 88.1) * 100 = 8.513 \text{ kW}$
INPUT POWER with S4RM (kW)	$(\text{kW} / \text{S4RM EFF}) * 100$	$(7.5 / 91.5) * 100 = 8.196 \text{ kW}$
DIFFERENCE in INPUT POWER	IE2 I/P kW – S4RM I/P kW	$8.513 - 8.196 = 0.317 \text{ kW}$
YEARLY SAVINGS	DIFFERENCE X 24 HOUR X 365 DAY X 10 RS PER UNIT	$0.317 \times 24 \times 365 \times 10 = \text{INR } 27,769.2 \text{ YEARLY}$



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Efficiency & Cost Savings of S4RM: Submersible Motor

S.NO	POWER [KW]	S4RM Standard Efficiency [%]	INDUCTION MOTOR Standard Efficiency [%]
1	3.7	85.9	75.6
2	5.5	87.6	78.3
3	7.5	87.2	78.4
4	11	89.6	78.9
5	18.5	90.5	82.9
6	22	90	82



Shakti Pumps : Innovation

Efficiency & Cost Savings of S4RM: Submersible Motor

EXAMPLE	ENERGY SAVINGS & COST IMPLEMENTATION FOR 22 KW S4RM MOTOR	
INPUT POWER with IE2 Motor (kW)	$(O/P \text{ kW} / \text{IE2 EFF}) * 100$	$(22 / 82) * 100 = 26.82$ kW
INPUT POWER with S4RM (kW)	$(\text{kW} / \text{S4RM EFF}) * 100$	$(22 / 90) * 100 = 24.44$ kW
DIFFERENCE in INPUT POWER	IE2 I/P kW – S4RM I/P kW	$26.82 - 24.44 = 2.38$ kW
YEARLY SAVINGS	DIFFERENCE X 24 HOUR X 365 DAY X 10 RS PER UNIT	$2.38 \times 24 \times 365 \times 10 =$ INR 2,08,488 YEARLY



Shakti Pumps : Innovation

Cost of Technology & Retrofit in the System

Total Project Cost : End to End (including O&M)

The entire innovation has been developed with total investment close to INR 10 Cr.

Retrofit that may be required at the client's location/plant/facility

It is retrofit replacement to the existing induction motors for pumping applications in DOL (Direct On Line) cases.

For a Pump Set to match the output power the pump need to be changed. For high power motors a v/f technology based motor starter is required for safe start of the motor. This special starter technology is also developed by Shakti Pumps, patented (4 patents) and launched as Elite Soft Starter product name.



Shakti Pumps : Innovation

Financials & Business Model

Business Model

Shakti is exploring to penetrate the market S4RM by focusing on **(Energy Saving Companies) ESCO model or Partnership model**

The future of the Business is based on developing energy efficient products and sharing the benefit and saving with the partners



Shakti Pumps : Innovation

Operation & Maintenance

Operation & Maintenance

This motor has got unique set of maintenance skills as it includes the process of taking out the magnetic rotor from the motor and assembling it back in motors.

One level of training is required to carry out these operations.

Conditions that may affect the operation

Till now we have figured out that it can run successfully in all the conditions with good grid conditions.

400 V, 50 Hz rated motor can successfully run a raw grid supply of 400+/- 10%, 49-51 Hz.



Shakti Pumps : Innovation

Market for the Product

Replication Potential of the Product

The potential of the product is huge in the market because it can be a direct replacement to the Induction Motors

Major Sectors

Industrial, Domestic and Agriculture

Cross-Sector Potential

This product has specific application where PMSM and BLDC motors are used along with controllers for energy efficient motors. It should be noted that this motor saves 3-4 % of operational losses without changing the drive.



Shakti Pumps : Innovation

Typical Impacts on Overall Pump System Efficiency

- Lets take the pump efficiency of other brand is **45%**.

With normal Induction motor of efficiency **82%** (Submersible 22 kW).

The overall efficiency of the system will be

- Total efficiency = $0.82 * 0.45 = 0.369$ or **36.9%**

- The Pump Efficiency of Shakti brand is **65%**.

With the S4 RM motor of efficiency 90 % (Submersible 22 kW).

The overall efficiency of the system will be

- Total efficiency = $0.9 * 0.65 = 0.585$



58.5%



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Overall Analysis

SL.	Parameter	Induction Motor	S4RM Motor	PMSM Motor	Implication
1	System Efficiency	Low	High	High	Energy Saving
2	Starting Current	7 to 8 times FL	4 to 5 times FL	Not applicable (drive)	Lower load on existing line
3	Full Load Current	High	Lower	Lower	Existing line can be used for more no. of loads
4	Power Factor	Lower	High (close to 1)	High (close to 1)	Better utilization of existing resources
5	VFD required	No	No	Yes	Less no. of components in the system
6	Discharge	Variable	Constant	Constant	High discharge even at low voltage
7	Initial Cost I	Lower	higher	Better than S4RM	ROI with in 3-4 years and save energy
8	Reliability	High	High	*Comparatively lower	*Higher no. of components can be managed by standby
9	RPM	2750-2850	**3000	*0-4000	**Fixed RPM, *User adjustable RPM feature



Advantage Shakti Pumps

Case Study

Comparison

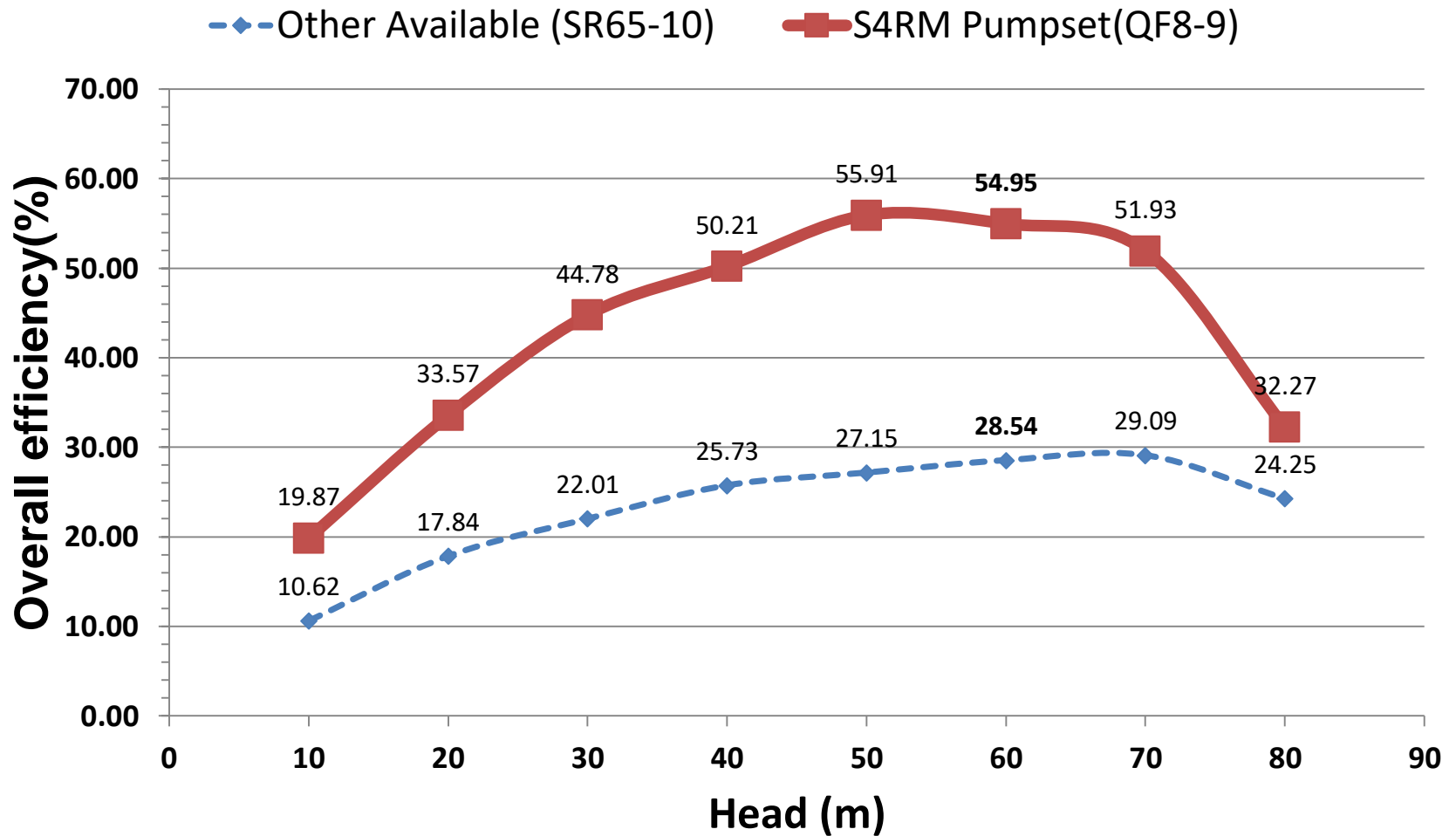


Study Pumping Station	Azad Nagar Indore	
	Existing Pump	Shakti Pump
Parameter		
Head (m)	90 m	90 m
Discharge (LPM)	181	183
Power (kW)	7.80 kW	4.27 kW
Run Time	646 hours	646 hours
Total Energy Consumption (kWh)	5044.18 kWh	2764.18 kWh
Cumulative Total flow (Ltrs.)	7015800 Ltrs.	7116700 Ltrs.
Energy Saving		45%



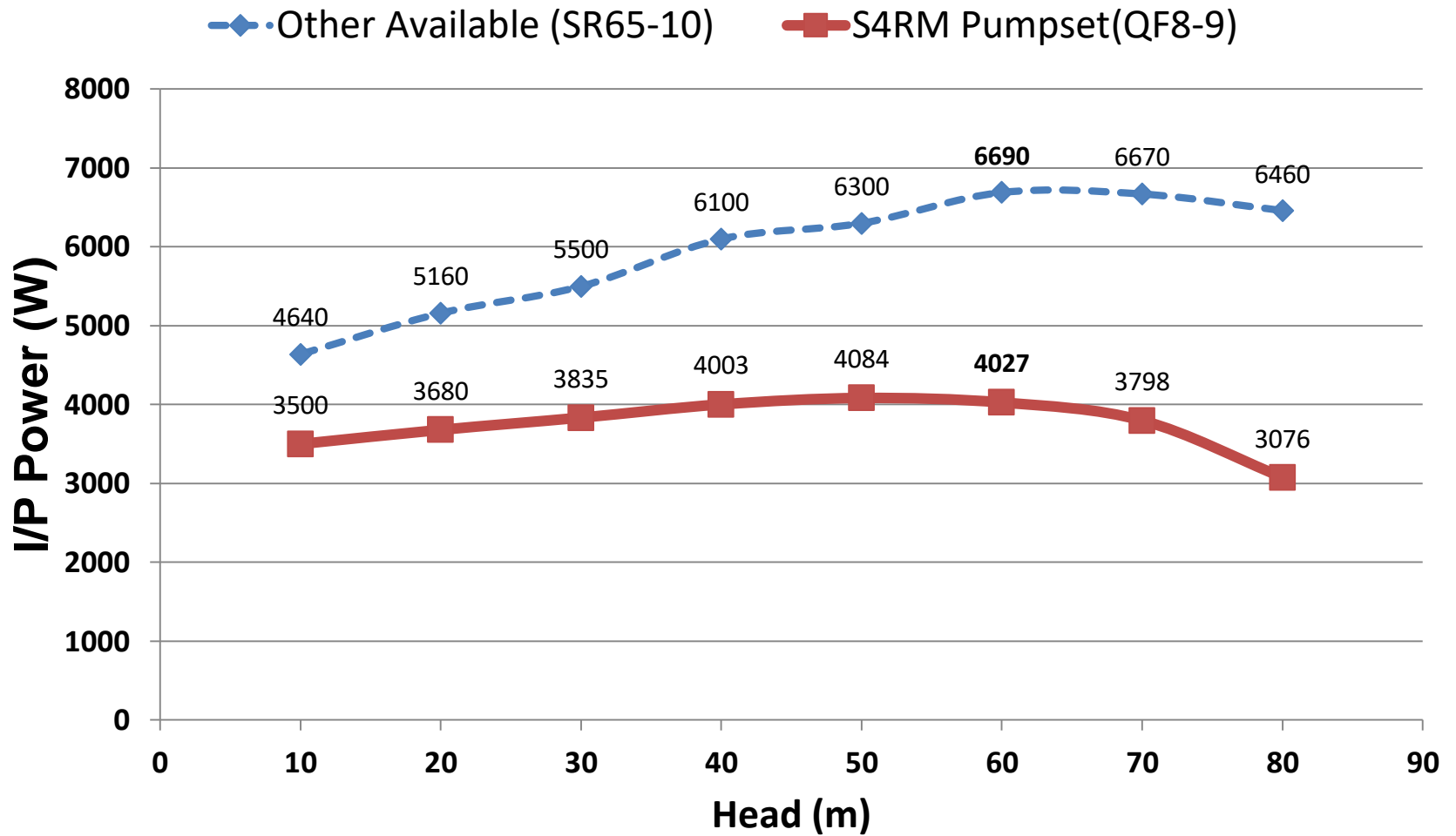
Advantage Shakti Pumps

Comparison of the Pump-set with other Brand



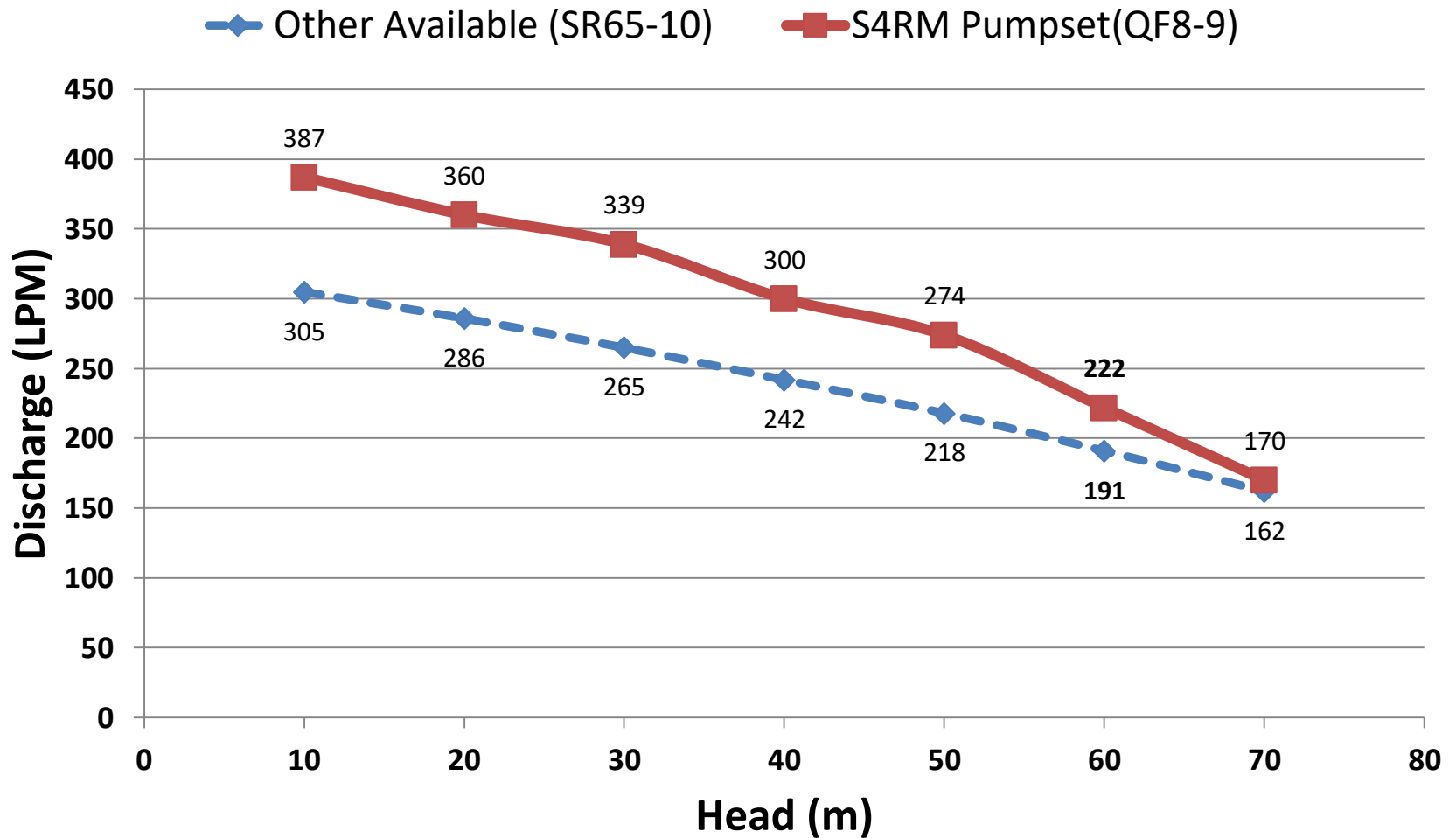
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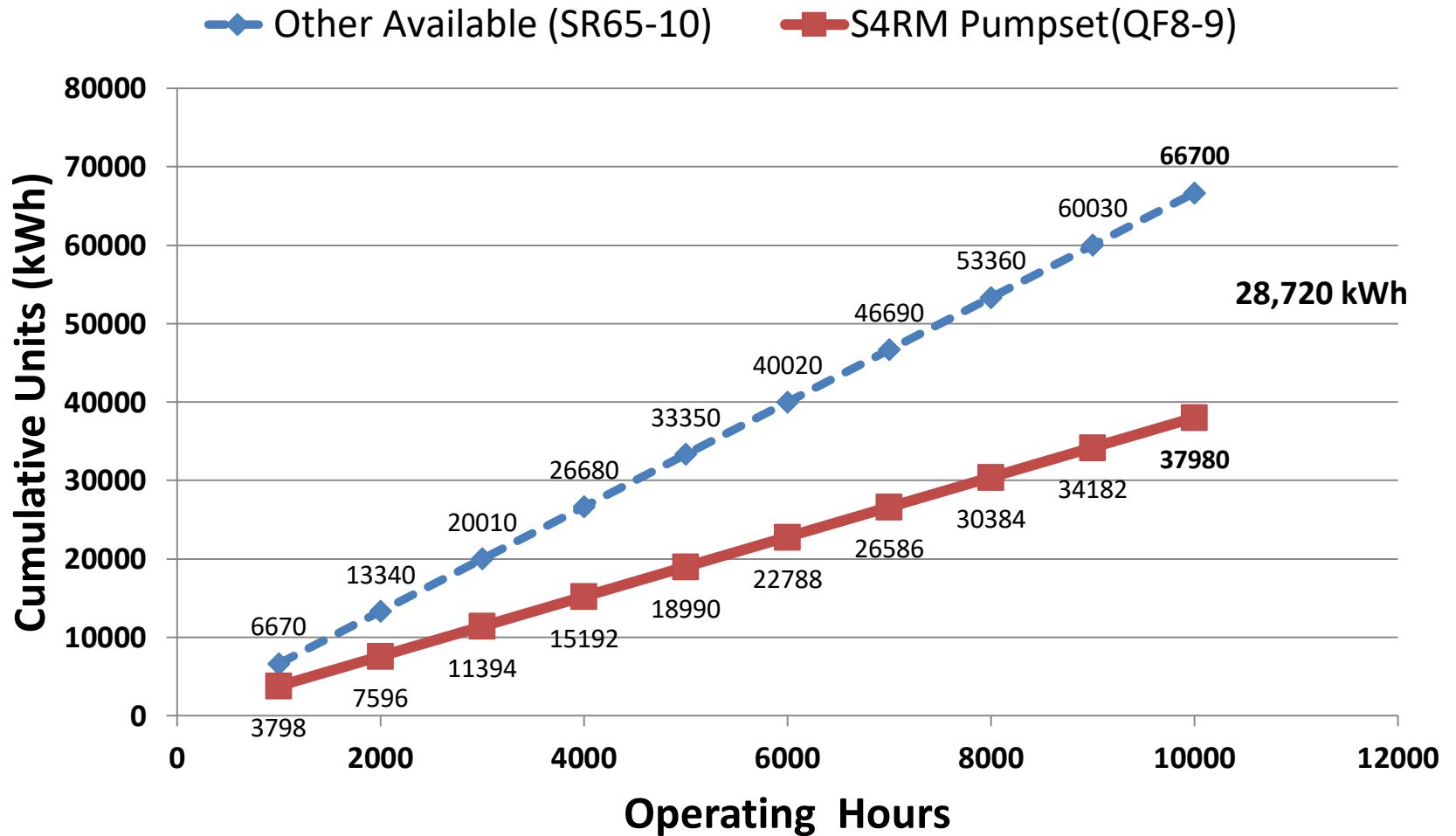
Advantage Shakti Pumps

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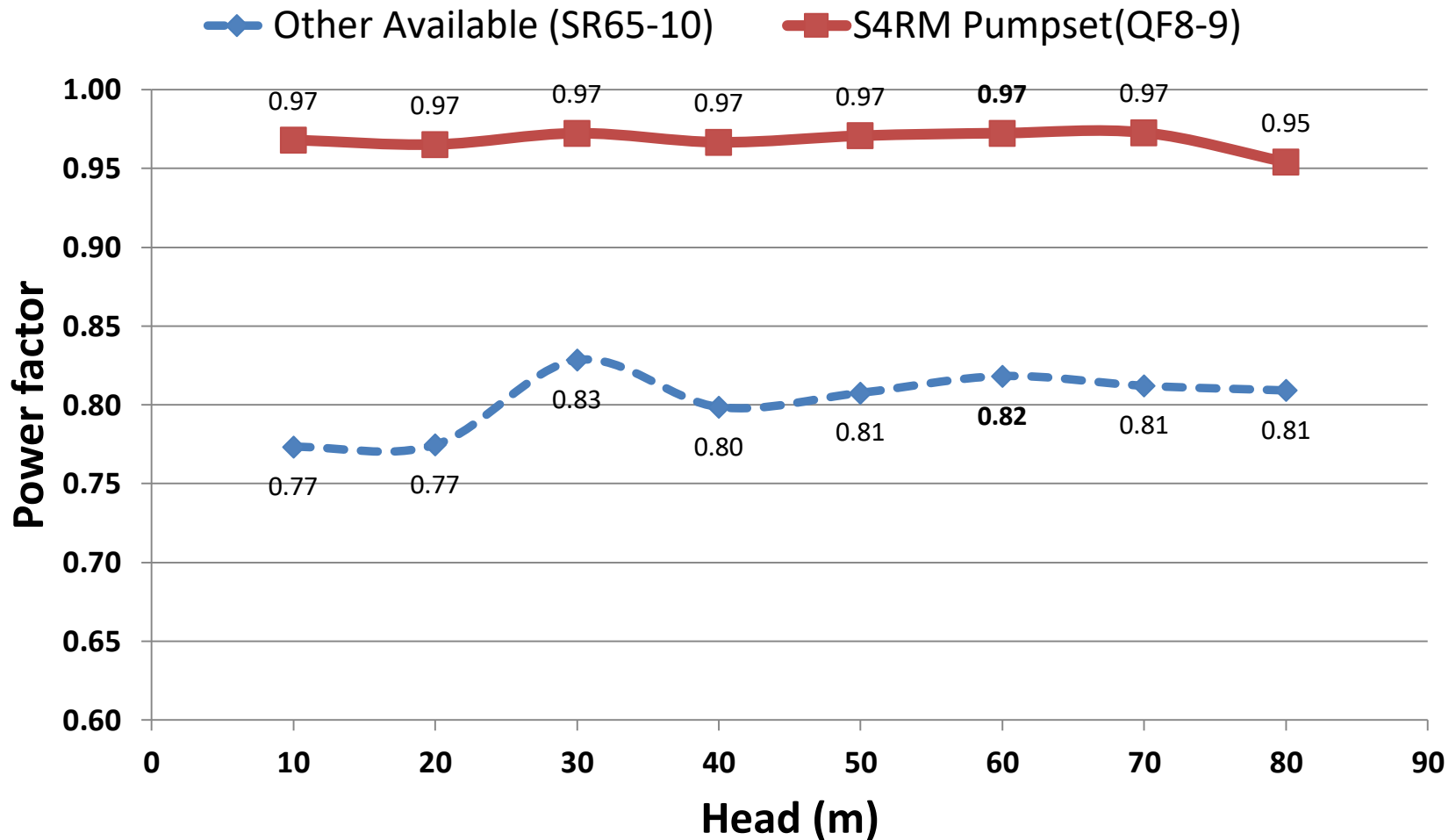
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Comparison of the Pump-set with other Brand



Advantage Shakti Pumps

Comparison of the Pump-set with other Brand



Thank You

