

2021 International Sucker Rod Pumping Virtual Workshop

February 8-12, 2021

Hydraulic Pumping Unit Evaluation. YPF

P.E. Dimas Reyes Senior Production Engineer and SRP Specialist



HPU, Hydraulic Pumping Unit (Review and History).

- Initially designed for long stroke without the drawbacks associated with the geometry of traditional pumping units.
- Mainly for deeper Wells (> 8000ft), high fluid rate, deviated well, gas problems, and other conditions when we long stroke and slow SPM is needed.
- Areas where they has visual impact limitations, and locations with several wells are drilled nearby, to improve installations time.
- When there are several wells with small distance in between, and in order to enter with pulling equipment it is necessary to stop and uninstall more than one well with traditional units, because of space limitation.



1940, Initially with many oil leak problems. Low pressure and high volume systems

1970, Parallel pulley and sling systems, Technology still limited

1985-1990, Manufacturers incorporate counterbalance system improvements

2000, Improvements in technology and monitoring allow to increase the flexibility of the equipment.

2010, some operators in Central and North America, increased the HPU park in mature fields. In México there are more than 1500 HPU installed in the actually

2021 International Sucker Rod Pumping Virtual Workshop

VELOCITY (IN/S

February 8-12, 2021 ficación YPF[®] No Confidencia

have been high maintenance equipment and also high frequent failures, in their history.

Some benefits

- \checkmark Lower initial cost of the complete set.
- \checkmark Production range can be wide. Flexibility to easily change speed and stroke length. And spacing the pump remotely in some models.
- ✓ Linear speeds during upstroke and downstroke, can be beneficial for the rod string.
- \checkmark Applications in deviated wells, deeper wells.
- ✓ For problems with high GOR, the longer stroke is always a good solution.
- ✓ Lower time and resources to install and uninstall. Space-saving and simple to operate. In Unconventional operations is a good alternative to don't stop more than one well when a WO equipment is needed.





2021 International Sucker Rod Pumping Virtual Workshop

Cargas Máx, Lbs

Potencia en Vástago 6.30 tencia en Romha

Carta de Superficie

Carta Fondo

have been high maintenance equipment and high frequent failures, in their history.

Disadvantages

- \checkmark High frequency of maintenance.
- ✓ If not operated adequately, the hydraulic leaks in the system can be a problem. The main challenge.
- ✓ The technology represents a challenge. Field staff training need to be improved.
- ✓ In general, very low speeds affect the pump efficiency due slippage. We need setting the correct relation between upstroke and downstroke velocities.
- ✓ If there is no counterbalance system, it can be inefficient compared to similar equipment with CB.





General Features

- The surface equipment that provides the power necessary to lift the sucker rods and fluid load to produce the fluids. Basically consists of two parts:
- The cylinder actuator to the well (some configurations with slings and pulleys parallel to the actuator cylinder)
- A hydraulic power station. Generally 50, 75, 100 and 125HP units. And can be MCI or electric motor.
- Counterbalance pneumatic systems (N2). Optional, in most cases is a necessary component if the efficiency is our priority.
- The Load cell and RPC systems are available. In some HPU's we can use the pressure sensors to take a Dynamometer data inferred from lifting pressure registered in the main cylinder during the stroke.
- Some models of HPU are connected in the well head directly, and we don't have the opportunity to install a rod rotator. We know that is important to some wells, not only low speed and long stroke are necessary to get a better performance in the wells.





Some models installed in our operations 3

2

HPU Identification

UDUMedel	Dowor UD	Maximum Load	Maximum	SPM	Balanced is	Can we intall		
HPU Wodel	Power, HP	Available, pounds	stroke, in	máximum	available, Y/N	rod rotator?		
H-75-22-192	75	22000	192	3,5	No	No		
H-100-30-192	100	30000	192	6,5	Yes and No	No		
H-50-30-144	50	30000	144	6	No	Yes		
H-100-36-220	100	36000	220	4	No	Yes		
H-125-35-288	125	35000	288	5	Yes and No	No		
H-100-40-192	100	40000	192	6,5	Yes and No	Yes		
E-150-40-336	150	40000	336	3,5	No	No		



Each manufacturer must deliver the characteristic curves of maximum spm vs load for the HPUs

2021 International Sucker Rod Pumping Virtual Workshop

February 8-12, 2021 Clasificación YPF: No Confidencial





Some models installed in our operations



Type 1: Installed axially on the wellhead. Model "Enclosed"





or de Proximidad

Acople rápido idráulico superio

Some models installed in our operations 2

3

Type 2: Installed with flanged pedestal.



2021 International Sucker Rod Pumping Virtual Workshop

Clasif Eebruary 8-02 fi 2021



Some models installed in our operations

Type 3: Installed with threaded base plate







Clasificación YPF: No Confidencial Artificial Lift R&D Council

Performance and overall efficiency in

Pump depth: 2652m Liquid production: 17m³/d Overall Eff: 43% Kw/m³/d⁻⁻: 0,6

SOil-178(h) - 20/12/2017 09:11 25000 20000 15000 10000 5000 140 PPRL MPRL **PU Model** SPM Stroke, in 23434 13336 M-912-365-168 3.6 168

This example represents a well with a Mark II unit, an average efficiency of 43%. It is very important take a reference target efficiency 50% in average as a best estimation. In some cases we can get 60% for example, with long strokes and low SPM.



2021 International Sucker Rod Pumping Virtual Workshop

SRP

Performance and overall efficiency in SRP With consumption measurements, we can deter

With consumption measurements, we can determine an efficiency near to 40% in a well with HPU with nitrogen counterbalance system. Using the same methodology to separate the power calculations at different nodes in the well.



2021 International Sucker Rod Pumping Virtual Workshop

Clasificación YPF: No Confidencial

Artificial Lift

R&D Counci



Performance and overall efficiency in SRP

Well	HPU Model	SPM	Stroke	Overall Efficiency	Liquid rate, m3/d	%Wcut	Pump depth, m	Kw/m³/d	PPRL	MPRL	Power Measurement, Hp	Sur Losse	face es, Hp	PRHP	Well Iosses, Hp	Pump HP	Other Losses, Hp	Hydraulic Power, Hp
A	H30-144LF	2,45	142	13%	12	0%	2691	1,83	20994	13515	29,50	24	,93	4,57	0,29	4,29	0,58	3,70
В	H40-192-HF	3,00	139	19%	22	0%	2585	1,14	22460	11830	33,53	26	,03	7,50	0,31	7,18	0,69	6,49
С	H40-192-HF	3,71	188	11%	25	1%	2751	2,16	24806	12182	72,42	58	,52	13,90	0,91	12,99	5,07	7,92
D	H40-192-HF	2,46	141	7%	14	0%	2732	3,43	22987	12396	64,37	58	,43	5,94	0,13	5,80	1,41	4,39
E	H30-144LF	2,50	142	9%	8	20%	2560	2,88	24899	15070	30,84	25	,49	5,36	0,17	5,19	2,41	2,78
F	H40-192-HF	2,86	189	11%	20	7%	2725	2,50	28374	15237	67,05	57	,88	9,17	0,34	8,83	1,78	7,05
G	HI 120 110 488	4,00	287	37%	45	93%	1975	0,60	25603	15108	36,21	8,	21	28,00	12,00	16,00	2,61	13,39
I	HI 120 110 488	2,31	287	13%	24	29%	2259	1,67	22916	8622	53,64	28	,55	25,09	16,64	8,45	1,26	7,19
J	M-912-365-168	2,90	149	43%	17	5%	2350	0,50	18843	7631	11,40	3,	40	8,00	1,38	6,62	1,75	4,87
К	M640-305-168	3,70	130	16%	8	5%	2814	1,63	24637	10327	17,43	6,	15	11,28	1,66	9,62	6,85	2,77
L	M-912-365-168	3,60	168	38%	17	5%	2652	0.59	23434	13336	13,41	5,	41	8.00	1,90	6,10	1.03	5,07

Well "K" with a pumping unit is operating out of balance. The comparison shows the HPU without pneumatic CB system have a similar low efficiency.



Performance and overall efficiency in



Current and power measurements have recorded efficiencies between 6% and 20%, and not higher in equipment without CB with N2.

Clasificación YPF: No Confidencial Artificial Lift R&D Council

Performance and overall efficiency in SRP

If the HPU does not have a counterbalance system, necessarily:

- Upstroke, the motor must supply the power to lift the rod string and fluid loads.
- Downstroke, the motor doesn't work, as the rods gravity drop into the well to bottom.

HPU without counterbalance system are less efficient. If the energy cost is a priority. The benefits mentioned above may not be attractive. Acquire current and power data periodically to evaluate the system performance.



Run time and monitoring of failures in HPUs installed, YPF experience.

Currently, the equipment's available in our operations is 30 HPUs, 60% local supplier.





The most critical components is the cylinder or actuator. The most common failures in our operations are: oil leaks, seal failures, low oil level, hydraulic pump failure, and particularly failures in the control system because it is a local development in the first installations. Studies of Operators and manufacturers (Hydraulic Rod Pump International, HRPI) as a whole show a life expectancy of the actuator cylinders, between 1 to 6 years. The highest cylinder life on record was 9 years.

February 8-12, 2021 Clasificación YPF: No Confidencial



Run time and monitoring of failures in HPUs installed, YPF experience.

Currently, the equipment's available in our operations is 30 HPUs, 50% local supplier.





The most critical components is the cylinder or actuator. The most common failures in our operations are: oil leaks, seal failures, low oil level, hydraulic pump failure, and particularly failures in the control system because it is a local development in the first installations. Studies of Operators and manufacturers (Hydraulic Rod Pump International, HRPI) as a whole show a life expectancy of the actuator cylinders, between 1 to 6 years. The highest cylinder life on record was 9 years.

February 8-12, 2021 Clasificación YPF: No Confidencial



Availability of operating time and monitoring of faults in HPUs installed, YPF experience.

The main reason of failures in our operations during 5 years.





Availability of operating time and monitoring of faults in HPUs installed, YPF experience.

Monitoring of monthly failures and quantity of HPUs installed and in operation. Monitoring is very important to measure the failure rate, and how this indicator evolves over time.

The differences between HPU and traditional pumping units is a significant challenge in operations. Especially to maintenance engineering, so that we can properly account for the benefits.





Conclusions and recommendations

- The system has flexibility for installation (3hrs approx), change of spm and stroke length. Remote operation simplifies and lowers operating costs.
- Results with long-stroke equipment allow operating wells with gas interference and flumping problems, to stabilizing the production. In deviated wells with the benefits associated with the low speeds at a lower initial cost.
- Important benefits are evident in locations with some wells om limited area.
- Reducing load cycles and linear speeds can be beneficial in wells with high failure rate.
- Consider that the efficiency can affect the decision to use or not this equipment when the impact is very high on the energy cost.
- The acquisition, must be accompanied by operational support and maintenance services, as well as having the opportunity to go through the learning curve from operation.
- Evaluate TCO, in the analysis period, considering including expectation of Efficiency and higher Maintenance (useful life of cylinders and hydraulic pump).

Acknowledgements,

► YPF

- ► Luis Mondino
- Federico Baieli
- Echometer Company
 - ► Tony Podio
 - ► Lynn Rowlan
 - Gustavo Fernández
- ► ALRDC and Organizing Committee

Thanks...



February 8-12, 2021 Clasificación YPF: No Confidencial

Clasificación YPF: No Confidencial

Artificial Lift

R&D Council



ANY Guestions?

2021 International Sucker Rod Pumping Virtual Workshop

February 8-12, 2021 Clasificación YPF: No Confidencial

Copyright

Rights to this presentation are owned by the company(ies) and/or author(s) listed on the title page. By submitting this presentation to the International Sucker Rod Pumping Workshop Workshop, they grant to the Workshop, and the Artificial Lift Research and Development Council (ALRDC) rights to:

- Display the presentation at the Workshop.
- Place the presentation on the <u>www.alrdc.com</u> web site, with access to the site to be as directed by the Workshop Steering Committee.
- Place the presentation on a CD for distribution and/or sale as directed by the Workshop Steering Committee.

Other uses of this presentation are prohibited without the expressed written permission of the company(ies) and/or author(s).

Clasificación YPF: No Confidencial Artificial Lift R&D Council

Disclaime

The following disclaimer shall be included as the last page of a Technical Presentation or Continuing Education Course. A similar disclaimer is included on the front page of the International Sucker Rod Pumping Workshop Web Site.

The Artificial Lift Research and Development Council and its officers and trustees, and the International Sucker Rod Pumping Workshop Workshop Steering Committee members, and their supporting organizations and companies (here-in-after referred to as the Sponsoring Organizations), and the author(s) of this Technical Presentation or Continuing Education Training Course and their company(ies), provide this presentation and/or training material at the International Sucker Rod Pumping Workshop "as is" without any warranty of any kind, express or implied, as to the accuracy of the information or the products or services referred to by any presenter (in so far as such warranties may be excluded under any relevant law) and these members and their companies will not be liable for unlawful actions and any losses or damage that may result from use of any presentation as a consequence of any inaccuracies in, or any omission from, the information which therein may be contained.

The views, opinions, and conclusions expressed in these presentations and/or training materials are those of the author and not necessarily those of the Sponsoring Organizations. The author is solely responsible for the content of the materials.

The Sponsoring Organizations cannot and do not warrant the accuracy of these documents beyond the source documents, although we do make every attempt to work from authoritative sources. The Sponsoring Organizations provide these presentations and/or training materials as a service. The Sponsoring Organizations make no representations or warranties, express or implied, with respect to the presentations and/or training materials, or any part thereof, including any warrantees of title, non-infringement of copyright or patent rights of others, merchantability, or fitness or suitability for any purpose.

Clasificación YPF: No Confic

Artificial L

R&D Counc