ALMA

SERVICES COMPANY

CycleOp

Smart control for submersible equipment

- Enhanced efficiency
- Integrated solution
- Improved reliability

CycleOp controls the entire lifecycle of downhole equipment

Design and incorporation

- Selects the best design to fit the operating conditions
- Calculates and builds well model
- Helps generate and keep the warranty certificate

Operation

- Controls the actual equipment condition
- Alerts and predicts the deviations and suggests optimization activities
- Provides recommendations and tracks their efficiency

Failure cause identification

- Collects the required data for Quality Assurance Day
- Analyzes punch lists and determines the repair category
- Creates KPI report

Improvement

- Conducts reliability analysis and creates the rating
- Assesses the efficiency and coverage of the applied activities
- Forecasts activities for KPI improvement

CycleOp foresees the major industry challenges and helps resolve them

How to find critical information in-house?

- E-based «Single-window» EIS
- Instant access to the required information for decision making

How to control 1 000+ wells per day and find the issue proactively?

- Unique set of expert and patented algorithms for failures forecasting and early warning
- Option to prioritize just the wells with deviations

How to assess whether the selected equipment and operational activities are efficient?

- Precise diagnostics and issues identification
- Knowledge base to stabilize and optimize the operation mode
- Selection of the optimum design
- Recording the activities outcomes and efficiency analysis

Whom to contact if you are left with the issue alone?

- Remote expert team to ensure continuous software enhancement and its incorporation at customers' facilities
- Continuous support during operation via the platform interface

CycleOp will boost production by 2-3% and reduce the costs by 5-10%

System optimization

E-based «Single-window» EIS

Saved deferment

Prompt response to deviations

Reduced operational costs

E-based «Single-window» EIS

Optimized costs for equipment operation

Selection of optimum energy-saving equipment

50+

functionalities contributing to the effect

Benefits in numbers

50-60%

Saved
oil deferment

15-25%

Reduced total cost
of ownership and operation

от 5%

Increased*
Oil Recovery Factor

от 30%

Runlife increase

от 11.5 hrs

Less man-hours
per unit**

55%

Less time spent for data search
for decision making

*with an IAM available

**managing the downhole pumping equipment lifecycle for all artificial lift methods: min. 8 hours per unit for other production methods

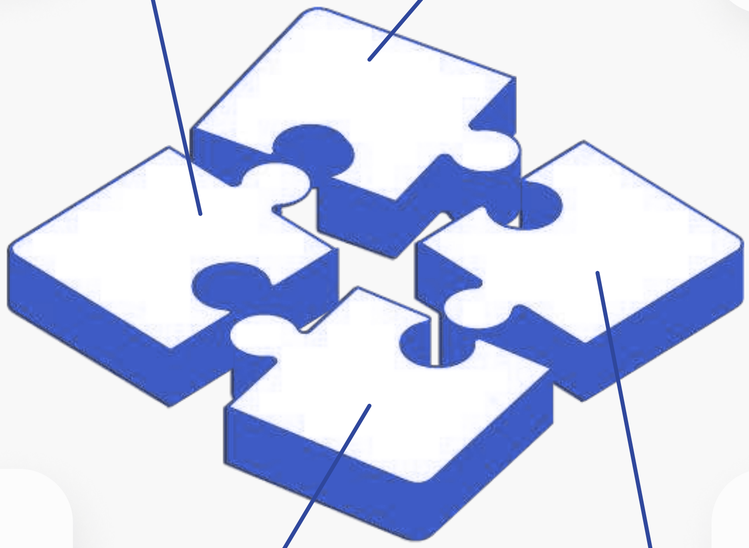
The platform comprises 4 products

Cyclеop Design

Equipment design selection

Cyclеop VMAP

Proactive monitoring and diagnostics of operational issues



Cyclеop DIFA

Reliability management

Cyclеop ID

Equipment accounting and flow

60

Algorithms to detect anomalies

Incorporation of product(s) or the platform

Application of physical models combined with machine learning models

User-friendly interface

- 24/7 data analysis using expert algorithms
- Customizable interface
- Full or partial incorporation (individual products) is available
- Smooth integration with pre-installed systems
- Selection of unit measurement system
- Adjustable reports and dashboards for various process teams
- Automatic upgrading of latest versions
- Just a few clicks to get all the required data to make a decision
- Multi-language interface

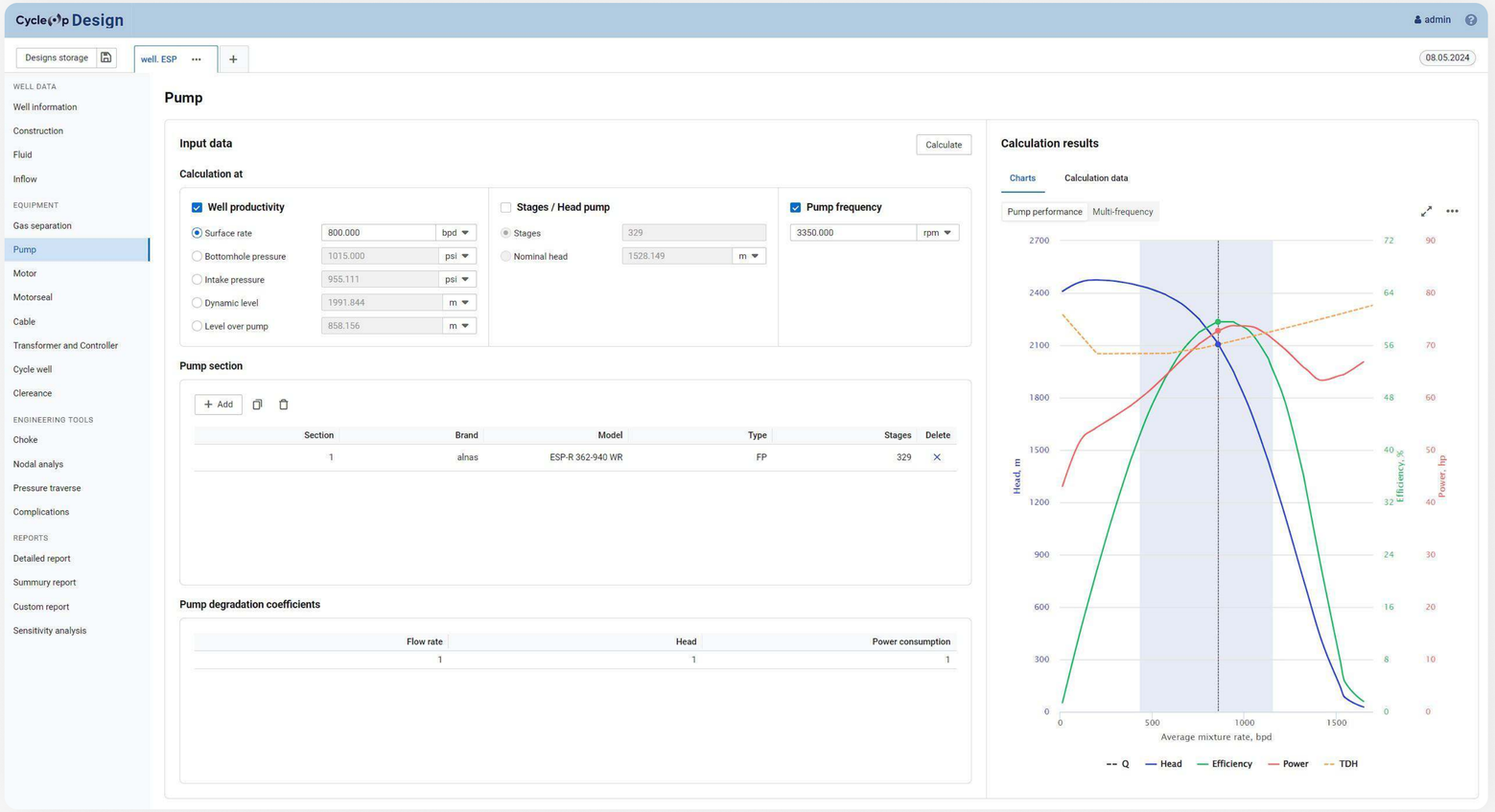
CycleOp Design

Equipment Design Selection

- Calculation of well operation model
- Selection of the appropriate artificial lift method: ESP, SRP, dual completion gas lift, natural lift, PCP
- PVT analysis based on Black Oil model as well as using lab data
- Multiphase flow design both for tubing and production casing
- Possible manual correction of MFP correlations
- Surface equipment design
- Editable database of the major manufacturers of surface and downhole equipment

Key benefits CycleOp Design

- One product - multiple production modes
- Availability-based selection of equipment
- Sensitivity analysis for equipment selection with accounting and KPI dynamics
- Automatic selection of the new assembly design available during the operation of the existing one
- Various operation modes: permanent, cyclic (time-based, parameter-based)
- Providing recommendations during selection of the equipment design
- Customizable final report



CycleOp VMAP

Early Warning and Diagnostics of Operational Issues

4 product modules via single interface:

V – Virtual flow meter

M – Monitoring and control of the actual condition of downhole equipment

A – Anomalies detection using instant and trend analysis

P – Prediction of failures using ML models

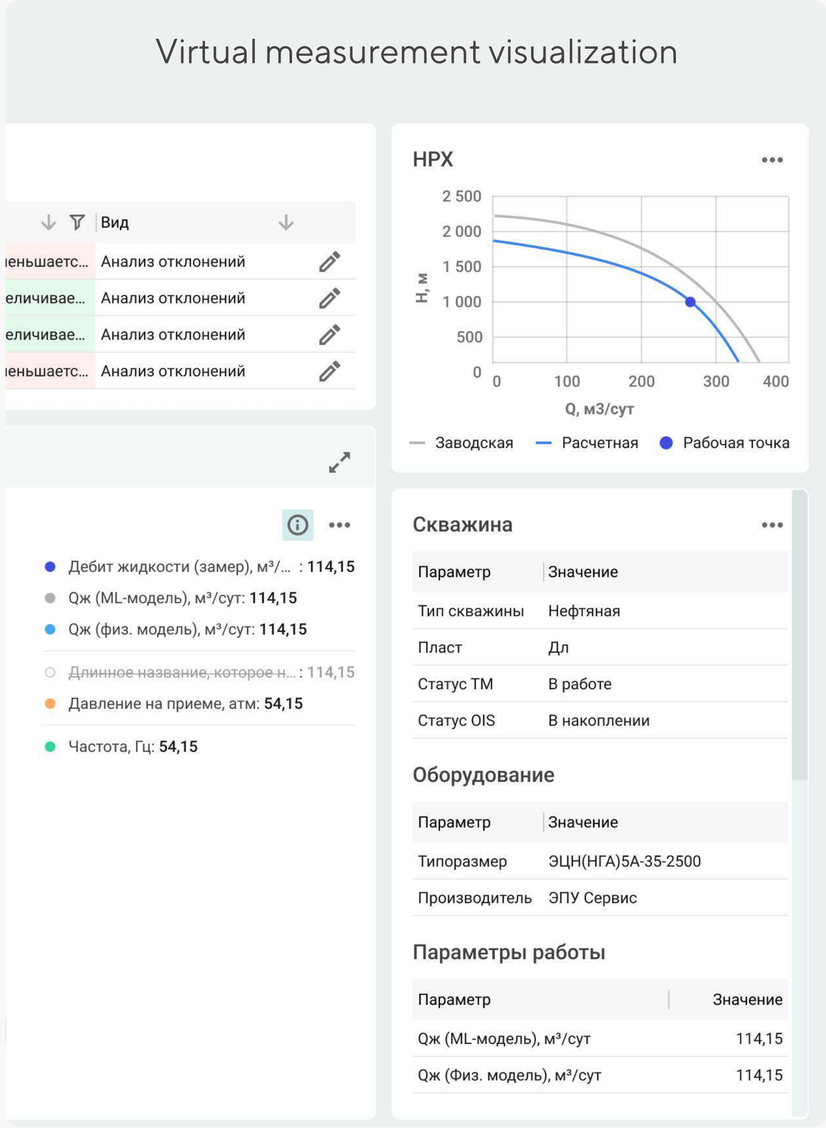
Extra:

- Visualization of mnemonics for a well with performance indication
- Customization of operational and business processes based on the Company's role model that ensures flexible process automation
- Management of operational requests
- Provision of required parameters to select the next ESP design for the well

Key benefits

- Monitoring and diagnostics of operational issues for ESP, SRP, PCP
- Evaluation of head and rate deterioration
- Forecasting of production gain due to optimization activities
- **Calculation of parameters:**
  - BHP
  - ESP suction temperature
  - Dynamic fluid level
  - Well productivity index
- Measurement of production rate in remote standalone wells with limited access

Virtual measurement visualization



CycleOp VMAP

Approaches comparison

Current practice

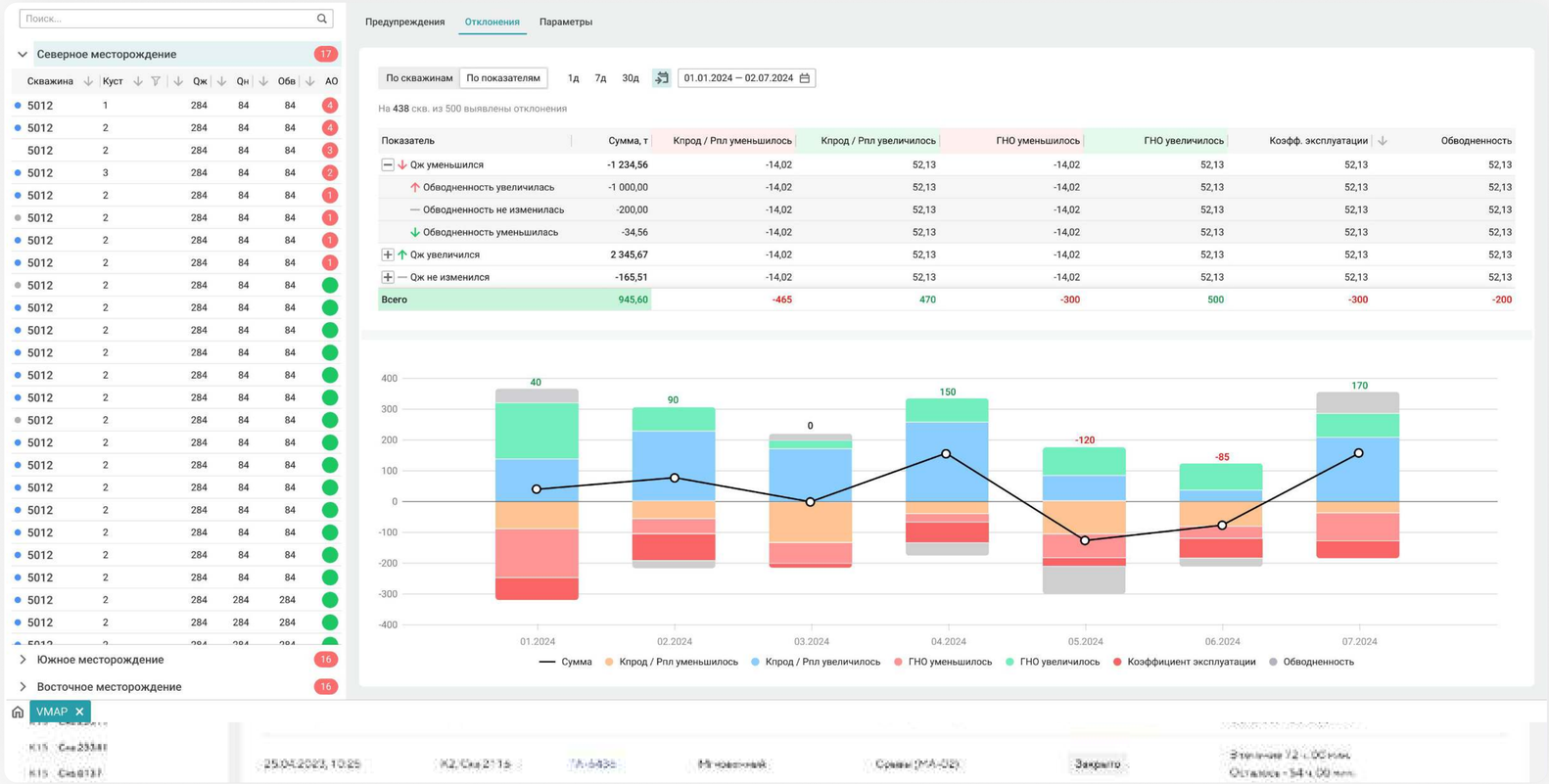
- In case the group metering station is not available, a high-cost mobilization of a mobile station is required
- If rate deviation is revealed a request is raised to conduct a non-scheduled measurement to confirm the actual parameters
- Physical measurement may be impossible or limited if there are complicating factors such as paraffins, high pressure, solids
- Wells measurements take place at least 5 times per month

CycleOp practice

- **Virtual production rate is available online (at every data refresh operation)**
- **Incompliance of the actual vs scheduled parameters becomes known at the time when the deviation occurs**
- **Sufficient time is available** to recover the scheduled operation mode, implement optimization activities or plan preventive actions

Key benefits

- **Single window**
  for monitoring numerous units
- **User-friendly navigation** between wells and configurable wells prioritization list
  Critical is first priority
- **Customized list of key parameters**
  to display based on specific production tasks
- **Analytical algorithms operating**
  in real time
- **A warning alert**, with the ability to trace the cause for the deviation, study the system recommendations and plan corrective actions



M и A – Monitoring, actual condition control, anomalies detection

CycleOp VMAP

Current practice

01 The issue becomes known during the walk rounds

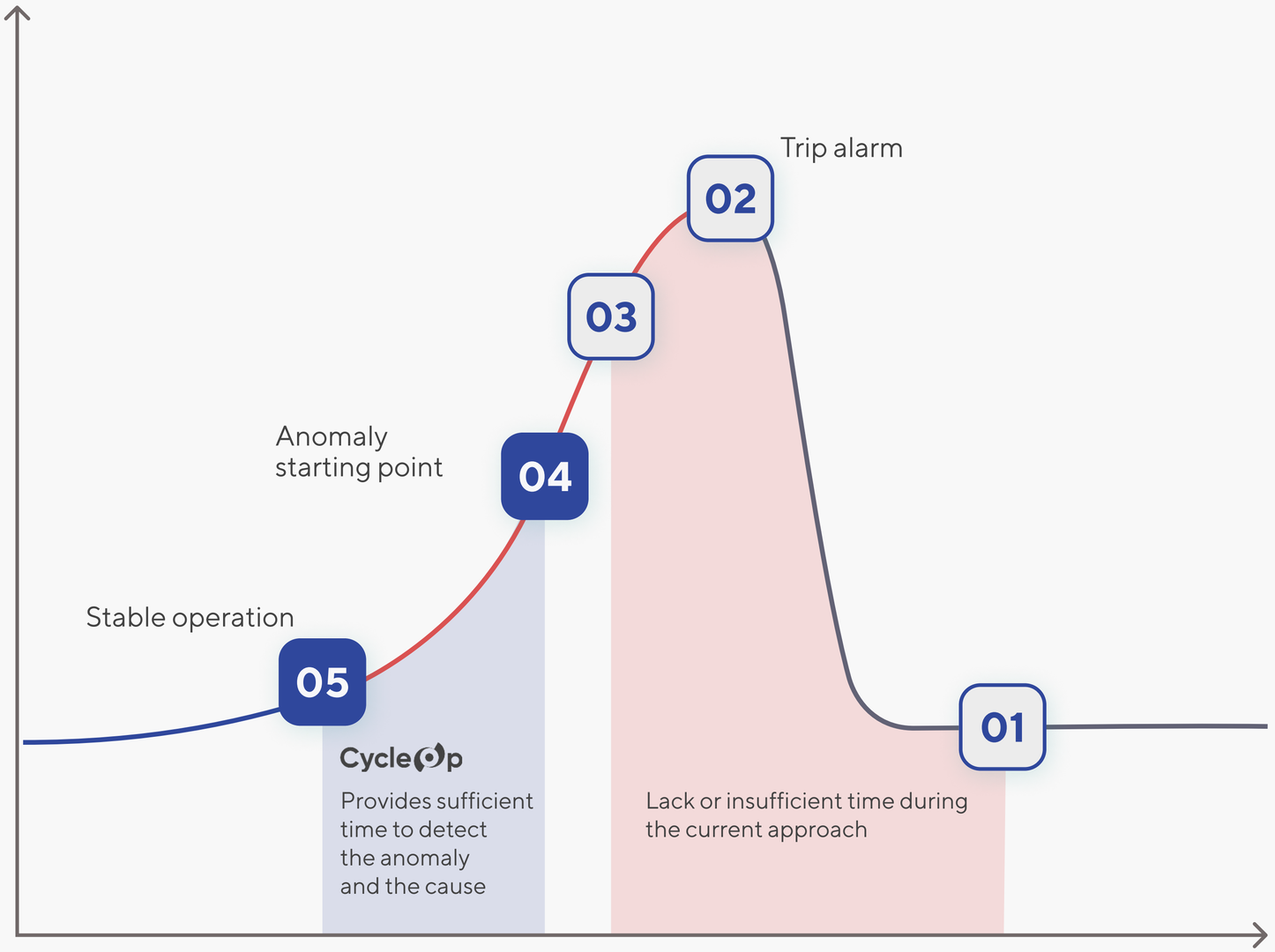
02 Trip alarm comes to the dispatcher workstation

03 Critical value (emergency) alarm— minimum time for response

CycleOp practice

04 **Instant analysis:** analysis of the parameter dynamics and forecasting the time when it comes close to the critical value. More time for response

05 **Trend analysis** — analysis of cumulative change of several parameters: fast detection of both the anomaly and the cause Sufficient time to correct the operation mode



CycleOp VMAP

Applied algorithms

Trend analysis

Complications:

- Wax buildup on the tubing internal walls
- Excessive gas content
- Solids or scaling on ESP stages
- Solids or scaling on ESP suction
- Scaling on motor body
- Pumping of viscous fluid

Leaking string:

- Leaking tubing w/o packer
- Leaking back pressure valve
- Leaking tubing above the packer
- Leaking tubing under the packer

Operation:

- Wellhead pressure increase
- Annulus pressure increase
- Annulus pressure reduction
- Reduction or increase of reservoir pressure and productivity index
- Water cut increase
- Cyclic mode

Submersible equipment:

- Insufficient head
- Stages wear
- Frequency reduction below the recommended value
- Broken shaft
- Reverse rotation

Surface equipment:

- Clogged back pressure valve
- Full valve closing on the surface
- Choke diameter increase

Close to trip settings

- Low suction pressure
- Low fluid level above the ESP suction
- High motor temperature
- Low resistance
- High linear pressure
- Annular pressure higher than the linear pressure
- Operating current higher than the rated value
- Current disbalance
- Underload
- Overload
- High voltage
- Low voltage
- High scale inhibitor residual

Instant analysis

- Wax buildup and increased gas production
- Solids
- No flow
- Operating point at the recommended range
- Failed telemetry readings

Key benefits

01
Calculation of remaining operation life

02
Calculation of health index for each well

03
Automatic input data validation

04
Model learning on incoming data

05
Proactive diagnostics of downhole pumping equipment deviations using expert algorithms and providing efficiency-based recommendations

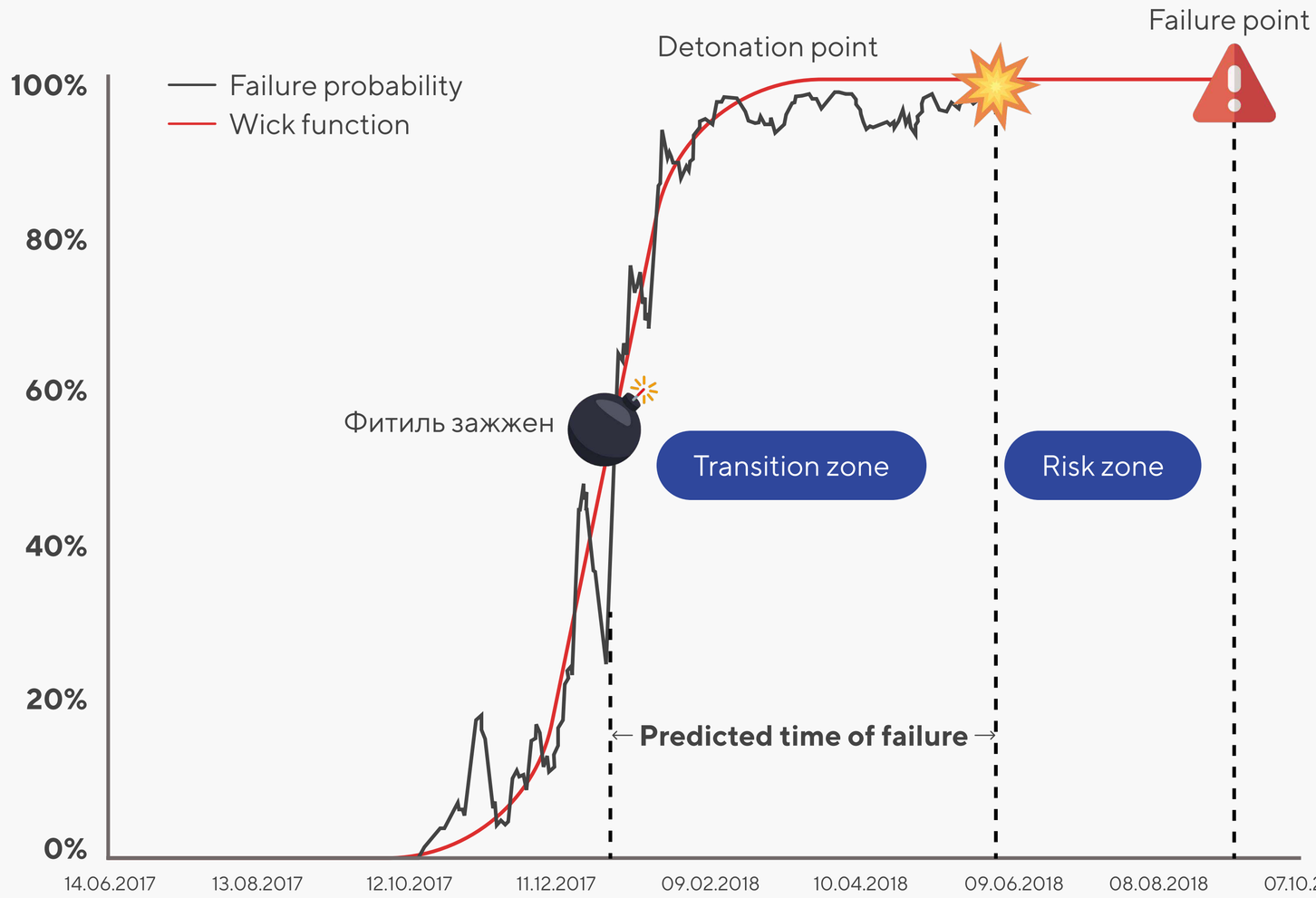
06
ML-based prediction of downhole equipment trips and failures, for SRP-using well dynamography

07
Building theoretic dynagraph (load curve) using physical digital twin with account of dynamic loads

08
Determining well candidates for optimization

Calculation of failure probability: the wick function concept

- The developed model predicts probability of ESP failure
- Probability dependence on time has a particular shape
- Failure probability can be approximated by the wick function



CycleOp ID

Equipment Accounting and Flow

- **Complete technical information about the downhole equipment being used**
  - materials
  - design
  - specifications
- **Information about wells, where equipment is used**
  - design
  - profile
- **Digital warranty certificate**
  - Equipment configuration
  - Assembly and RIH information
  - Ramping up spreadsheet
  - Tear-down data
- **Accounting of actual equipment flow from manufacturing till write off**

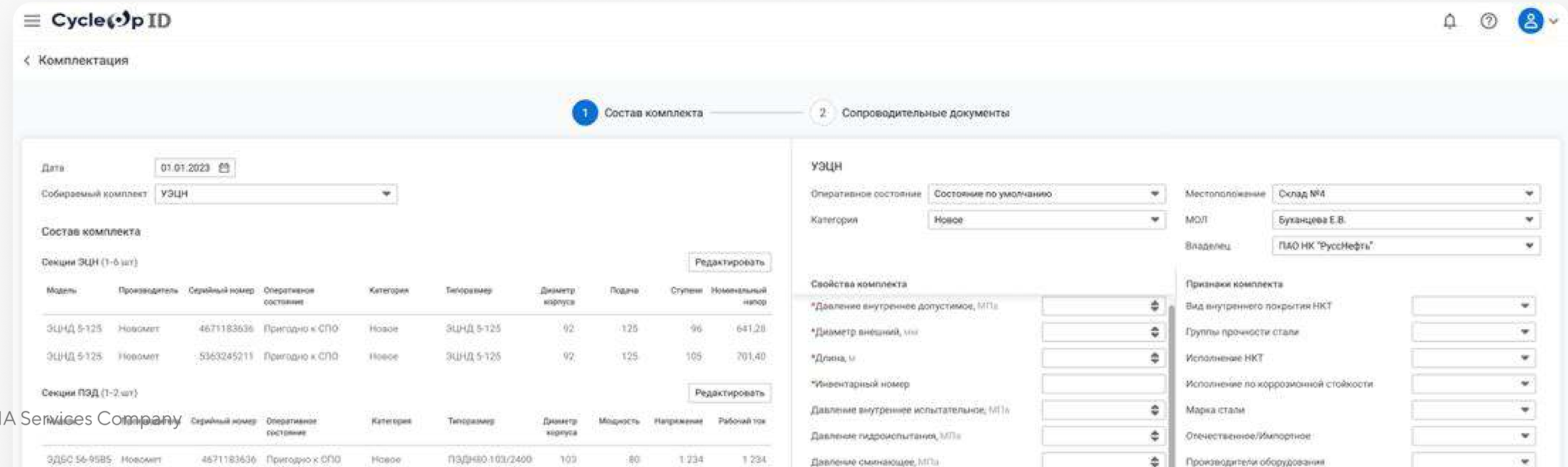
Key benefits

E-document management

- E-Request exchange
- High level of information security
- Less mistakes than in 2 and more accounting DBs
- Fast processing of the documents
- Storing scanned documents
- Transition from verbal (over the phone) to electronic coordination

Accounting process

- Creating a nomenclature list of equipment
- Adding a new nomenclature list of equipment to accounting procedure
- Recording incoming equipment
- Input of assembly/start-up data
- Recording failures
- Input of POOH/tear-down data



CycleOp DIFA

Reliability Management

- Failure cause database with integrated classifier by various industry standards
- Analysis of equipment reliability and providing recommendations related to usage of different types of equipment depending on operation conditions
- Drawing the Quality Assurance Day reports
- Digital punch list for the main equipment elements
- Knowledge base on possible activities to increase equipment reliability
- Chat with expert team to solve relevant issues

Remote Intelligent Monitoring Center (RIMC) has been launched in 2024

- ALMA RIMC center will provide 24/7/365 remote monitoring for ESP and surface rotating equipment
- A team of highly qualified specialists is being formed including those with experience of working internationally
- Suitable for producing and service companies

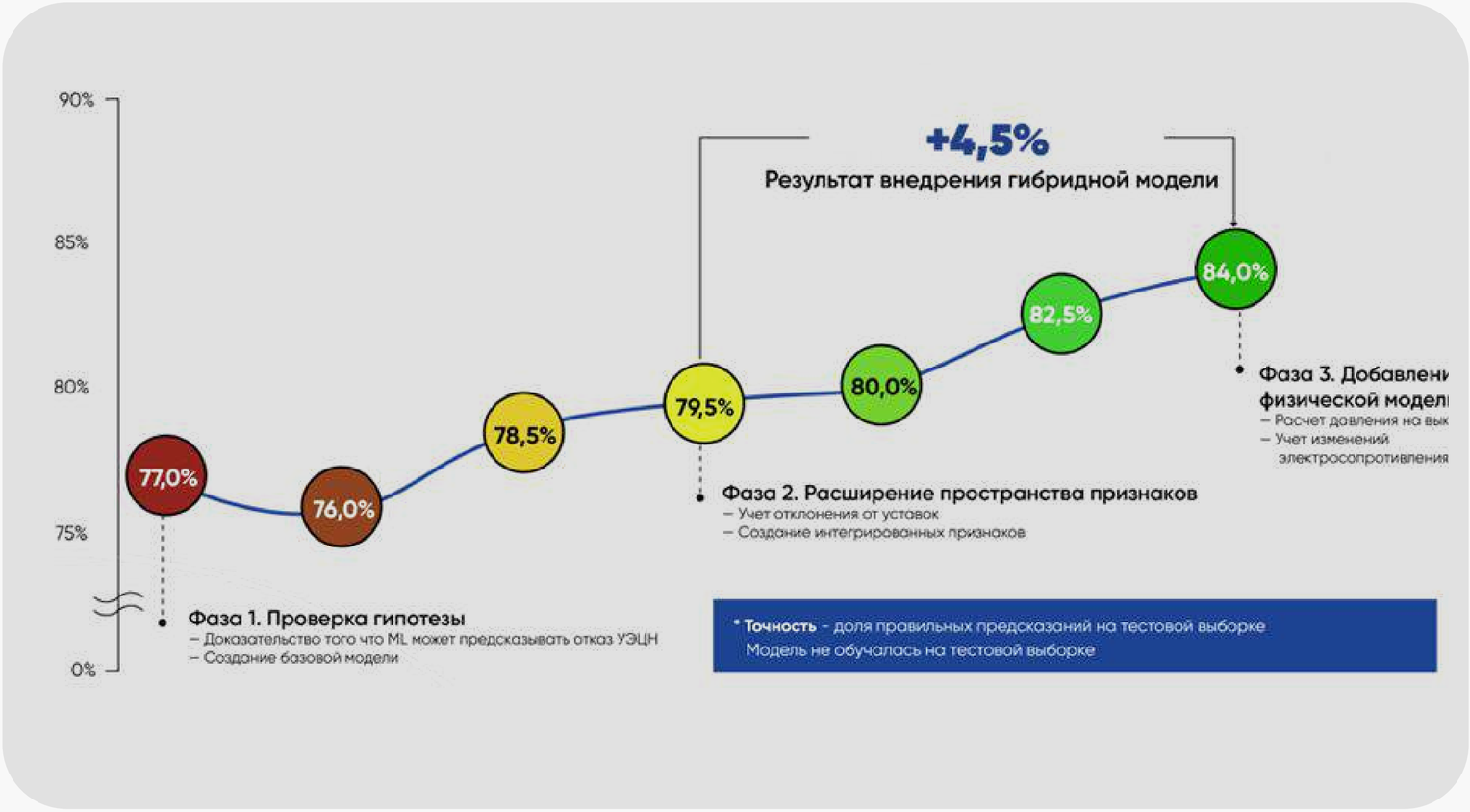
Case: Salym Petroleum Development

Task

Failure prediction; failure cause prediction; health index

Solution

- Data on 233 failures of 4 types
- 69 process parameters for each well + data on well design, ESP data sheet information, failures and trips data, etc.
- Usage of integral tests
- Hybrid model, parameters calculated using physical models are original features of ML model (engine cooling efficiency, pump discharge pressure, telemetry data recovery)



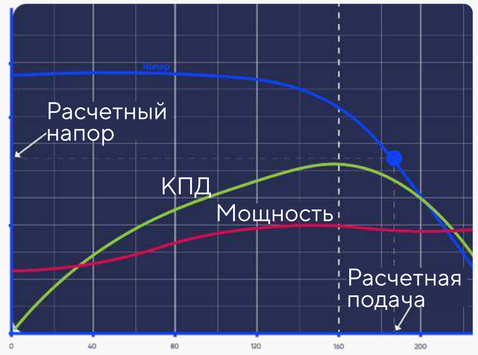
Result

- The model accuracy is 84%
- The second phase of the pilot project is currently being implemented

Case: LUKOIL PJSC / Ritek LLC

Task

Development of the System prototype for virtual flow metering and well stock operation analysis, designed to study various approaches to determine production rate and to monitor wells



Подача, м^3/сут

Solution

- Developed and implemented CycleOp VMAP-based software which provides the physical model of virtual flow meter and ML model for ESP
- Improved CycleOp VMAP module of Instant analysis of downhole pumping equipment condition to account for equipment specific features and LUKOIL Mid-East Limited conditions. Improved module was deployed in IT-infrastructure of LUKOIL Mid-East Limited

Result

- Performed tests of various approaches for creation of virtual flow metering systems for different types of downhole pumping equipment
- Aligned integration with information systems which provide original information for CycleOp VMAP (OIS and Telescope)
- Average error of virtual flow meter is less than 10%
- Full-scale implementation of the virtual flow meter and deviation analysis system is currently being performed on the whole well stock of RITEK LLC

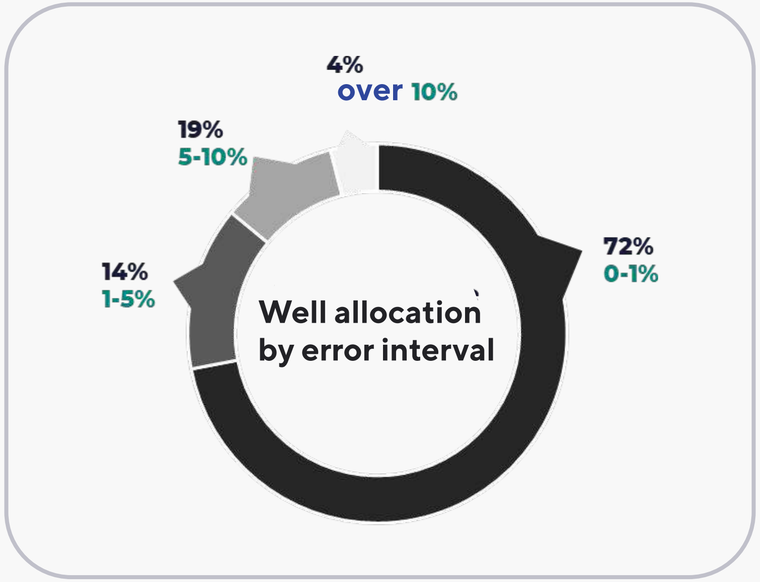
Case: LUKOIL Mid-East Limited

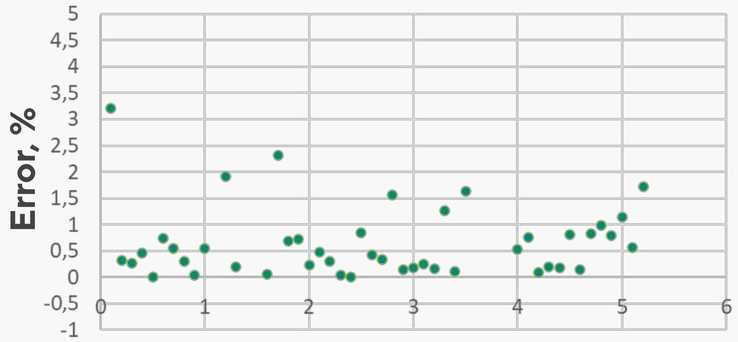
Task

Development of virtual flow metering system and proactive monitoring and diagnostics of downhole pumping equipment

Solution

- Developed and implemented CycleOp VMAP-based software which provides physical model of virtual flow meter and ML model for ESP
- Improved CycleOp VMAP module of Instant analysis of downhole pumping equipment condition to account for equipment specific features and LUKOIL Mid-East Limited conditions. Improved module was deployed in IT-infrastructure of LUKOIL Mid-East Limited





The dots represent error for 53 wells

Result

- **For 86% of the wells - calculation error of virtual flow meter is less than 5%**
  For 72% of the wells - calculation error of virtual flow meter is less than 1%
  For the whole well stock - calculation error of virtual flow meter is less than 1.8%
- **Confirmed correct functioning of 4 algorithms of the CycleOp VMAP instant analysis module**
- **Aligned integration with information systems which provide original information for CycleOp VMAP (OSISoft PI)**

We are ALMA group of companies

founded in 2017

200+ Employees

35+ Implemented projects for LUKOIL

- **ALMA Services Company (Moscow):**
  an accredited IT-company in the Russian Federation specializing in software development and incorporation
- **NAFTA Expert (Perm):**
  development of unmanned management concepts, digital transformation, integrated modelling
- **ALMA Consulting Expert (Moscow):**
  business-process engineering, industry benchmarking

These companies trust us

CycleOp

Solving challenges with CycleOp

Polukeev Dmitri Ivanovich

dpolukeev@almaservices.ru

www.almaservices.ru