PIPELINE PRE-COMMISSIONING PRE-QUALIFICATION DOCUMENT

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1. INTRODUCTION

Offshore Construction Specialists (OCS) was formed in 2007 from a core group of marine construction engineers to provide construction management, engineering and strategic support equipment services primarily to the offshore oil and gas sector.

Our key personnel come from previous careers at the multinational marine construction companyMcDermott working in the marine operations department on projects covering every sphere of theindustry. Our managing and technical director Mr Keith Jackson worked for 17 years in the group the last 5 years as the marine division manager.

As a matter of policy under Mr Jackson J.Ray McDermott would execute work peripheral to that being undertaken by the major work vessel (normally executed using third party subcontractors) using in-house resources. Pipeline pre-commissioning, pre and post trenching, flexible flowline / umbilical lay are examples of work that was routinely carried out in-house and not subcontracted.One of the main reasons for doing this was that it prevented the activities of the subcontractor impinging on the work of the high cost marine spread. The work was always planned with maximum operational synergy in mind

In JRM large pipeline pre-commissioning projects such as the 650 km West Natuna gas gathering pipeline network and many other major projects were planned and executed in-house.

OCS has taken the model developed in JRM and applied it to our own activities. Our equipment is managed and operated by people who come from the same background as the main marine contractor. We help the marine contractor plan the work such that the pre-commissioning has the least possible impact on operations. We are proactive in highlighting potential issues and ensuring both parties win. Our engineering capabilities are very sophisticated and significantly more advanced than our competitors.

OCS has now completed a range of pre-commissioning projects for many different customers with great success. OCS has been certified by Nata for pipeline hydrotesting since 2013. The OCS organisation as a whole has also been qualified to IS0 9001 since 2009.

In 2014 the company purchased premises at 36 Kian Teck Road in the Pioneer district of Singapore and we have established it as a base for our engineering and subcontract activities. The office and workshop serve as a base from which to plan and execute projects. The workshop has a dedicated instrument room where all calibrated instruments are maintained and the workshop facilities ensure that OCS mechanical equipment can be well serviced and maintained to high standards. The engineering and construction management group works handin hand with the pre-commissioning teams.

Our in-house equipment spread has grown significantly and is described in detail in this document. OCS is equipped to handle the full range of pre-commissioning activities including flooding, cleaning, gauging, hydrotesting, dewatering, drying and nitrogen packing. We work withestablished and reputable intelligent pig suppliers to complement our service. We have established long term relationships with key Singapore and overseas vendors.

We employ dedicated career inhouse technicians to operate and maintain our equipment and an equipment engineer to ensure our equipment is managed and maintained correctly. This enables OCS to prepare and mobilise efficiently for projects.

OCS is equipped to handle large projects or discrete project elements depending on the specificneeds of the customer.

The company has grown steadily since incorporation and now employs 60 personnel of whom 30are civil / structural and mechanical engineers working with our pre-commissioning technicians.

2. OCS ORGANISATION CHART

KEY PERSONNEL CONTACTS

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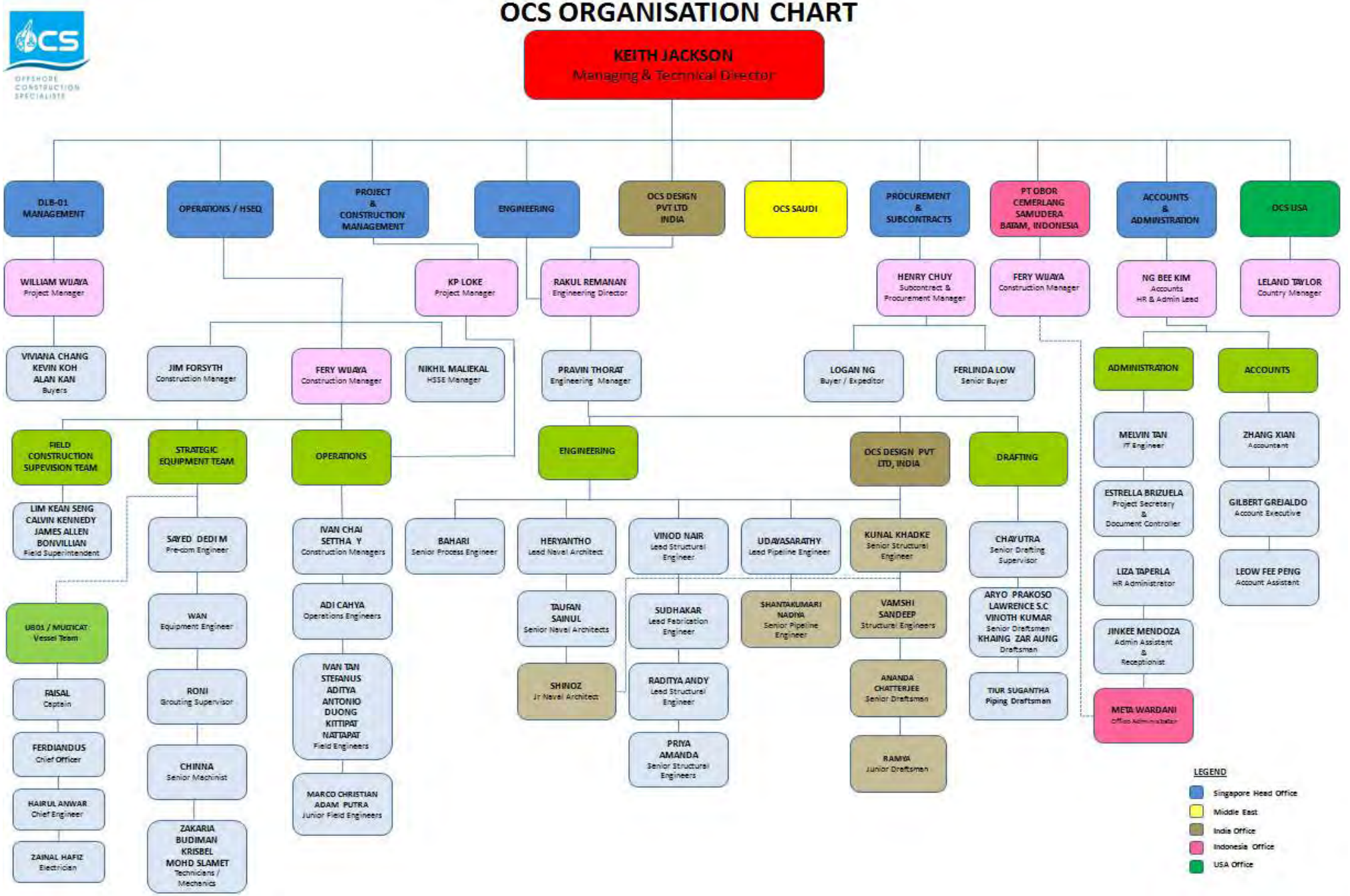
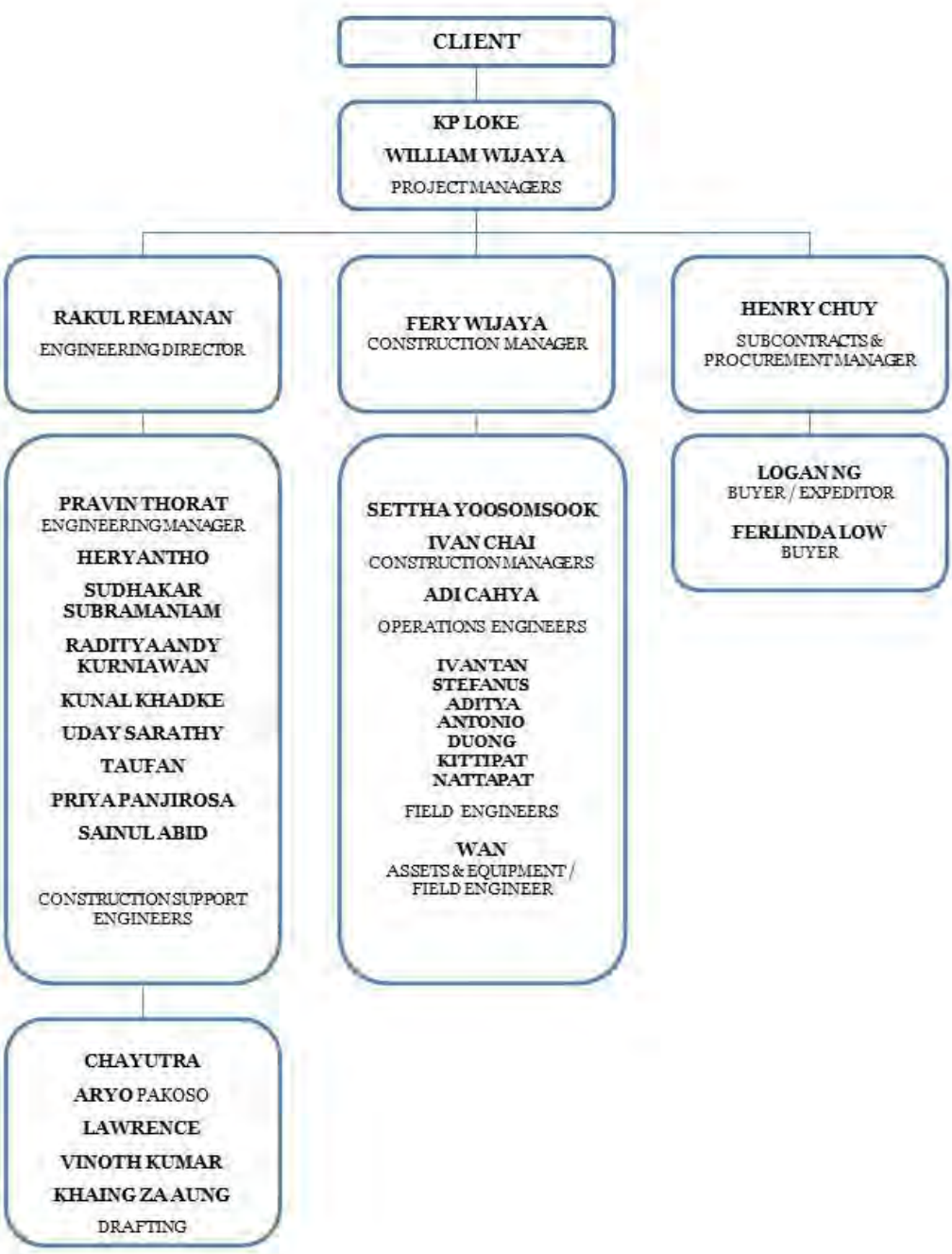
OCS ORGANISATION CHART



3. TYPICAL PRECOMMISSIONING ORGANISATION CHART

OCS Pre-Commissioning Team Offshore



Note: Project Managers, Project Engineers & Pre-Commissioning will be selected from the personnel pool shown for each category.

4. PIPELINE PRECOMMISSIONING ACTIVITIES

OCS experience embraces the full range of pipeline pre-commissioning activities from the initial flooding, cleaning, gauging and hydrotesting to dewatering, drying and nitrogen purging and packing.

Specific activities undertaken by OCS:

No.	Description
1	Flooding, Cleaning and Gauging
2	Calliper and Intelligent Pigging
3	Hydrotesting
4	Dewatering/ Swabbing
5	Air Drying
6	Vacuum Drying
7	Nitrogen Purging
8	Nitrogen Packing

OCS provides a cradle to grave pipeline pre-commissioning services including complete engineering, procurement, fabrication and execution services. Our in-house inventory is extensive and our personnel are well trained.

5. SAFETY AND SAFE WORKING PRACTICES

OCS is acutely aware of the dangers involved in the marine construction industry in general and inpipeline pre-commissioning particularly where high pressure water and air and heavy equipment, chemicals etc combine to create a range of potential hazards if not managed properly.

All OCS activities on specific projects are the subject of hazids and risk assessments to ensure levels of risk are reduced to as low as reasonably practical (ALARP). These risk assessments are ideally attended by the main contractor and the ultimate client.

Other specific safety and operational measures that are taken:

i) All OCS personnel have appropriate Bosiet offshore sea survival training
ii) OCS technicians are NATA qualified and well trained for their specific duties
iii) All OCS equipment is provided with a specific safety passport.
iv) Offshore hazardous areas are barricaded as required and unauthorized personnel areexcluded.
v) All installation aids are properly engineered and subject to structural checks by the OCS CSE group.
vi) Appropriate Hazchem sheets are posted in areas where chemicals are in use.

6. ENGINEERING AND PROCEDURES

OCS prepares project specific engineering and procedures for each job undertaken. What sets OCS apart from other pre-commissioning contractors is our engineering skills base which means that all structural, mechanical, hydrodynamic and aerodynamic considerations are addressed in- house. OCS procedures will

address:

i) Project specific procurement requirements.
ii) Equipment specification requirements and preparations.
iii) Designs of Pig launchers and receivers for Flooding, Cleaning and Gauging.
iv) Designs of Hydrotest heads.
v) Designs of Pig Launchers and Receivers for Dewatering and Drying.
vi) Pig Requirements and Designations.
vii) Intelligent and Calliper Pigging requirements.
viii) Chemical injection requirements.
ix) Hydrotesting pressurization, strength and leak tests.
x) Bulk Dewatering.
xi) Drying Procedures using Air or Vacuum drying techniques.
xii) Nitrogen Packing.
xiii) Engineering calculations for Equipment lifting frames and skids to the requirements of the nominated third party certification agency.

Engineering performed is strictly in line with the Client contract specifications and all documents are submitted for approval by the main Contractor (where applicable) and the ultimate Client / Operator / Owner as appropriate.

7. PROCUREMENT & SUBCONTRACTING

OCS inhouse procurement group has established vendors in Singapore and internationally. Procurement requirements will vary but the following general categories apply.

i) Purchase of Chemical and Dye for pipeline flooding activities.
ii) Specific Pigs for the Contract application.
iii) Fabrication of Pre-commissioning heads for Pigging, Hydrotesting, Dewatering, Drying and Packing. Heads are designed for above water or subsea applications as required. In certain instance OCS will fabricate the heads inhouse.
iv) Rental of specific equipment that may be required in addition to inhouse equipment.
v) Purchase of Liquid or Compressed Nitrogen and ISO tanks / Quads in which to transport it.
vi) Hoses and fittings
vii) Third party instrument calibration.
viii) Commercial transport

8. FABRICATION

Fabrication that will be carried out for specific pre-commissioning projects may include:

- Specific equipment lifting and handling frames.
- Flooding, hydrotesting, dewatering, drying and nitrogen purging and packing heads.
- Specific manifolds as required.

9. PIPELINE FLOODING, CLEANING AND GAUGING.

The following summarizes the major issues that are addressed during planning and execution.

i) Client's specification to be addressed and pumps and related equipment to be selected with the right volume and pressure rating to meet the requirements specified for pig speed.

ii) Cleaning and Gauging Pigs to be selected to suit the required application. Gauging platesto be sized in accordance with specification requirements. The front and last pigs will usually be fitted with pingers or tracking devices to enable the location of the pig train to be monitored.

iii) Chemicals to be assigned in accordance with the protection requirements of the specification and environmental considerations specific to the host country in which the work is being carried out. Where disposal of treated water is onshore special treatment procedures to be put in place.

iv) Procedures to account for the nature of the flooding operation :
- Onshore to Onshore
- Platform to Platform.
- Platform to Onshore (or reverse)
- Platform to Subsea. (or reverse)
- Subsea to Subsea.

v) Pig launchers and receivers to be designed and fabricated as required compatible with the pig train to be launched and received. Where pig launching and / or receipt is subsea measures to be put in place to protect divers. On platforms and onshore personnel safety to be give the highest priority accounting for proximity to the handling of high volumes of pressurized water.

vi) Calibrated Instrumentation provided to measure and record pressure and flow during flooding operations.

vii) Where pipeline installation operations involve subsea tie in connections the pipeline will need to be flooded to allow diver access to flange connections. In such cases pigging operations may have to be conducted before and after the connections are made up.

viii) Where the pipelines are constructed from Corrosion Resistant Alloy (CRA) material special precautions will be required to avoid exposure of the pipeline to raw seawater. This may involve the use of Gel plugs and other protection measure as discussed and agreed with the client.

10. PIPELINE INTELLIGENT AND CALLIPER PIGGING

For certain pipelines intelligent pigging may be specified for the pipeline. This can take the formof:

i) Caliper pigging which measures the internal bore of the pipeline and detects deformities along the length of the pipelines providing information on the exact linear location and orientation of the deformity.

ii) MFL pigging which measure the wall thickness of the pipeline with corresponding linearand orientation data.

This pigging is sometimes specified for new pipelines to establish a baseline from against which subsequent measurements can be compared. For existing pipelines it is used to assess damage that may have been sustained and /or the extent of corrosion in the pipe wall.
The intelligent pigs are fitted with batteries which have a finite life and this must be considered when loading the pigs to ensure the length of the operation from loading to receipt will not exceedthe battery life. This can be a critical consideration when subsea pigging is contemplated.Intelligent pigs are normally run from platform to platform or platform to shore (or reverse).

Intelligent pigs contain very sensitive instrumentation that is easily damaged so it is important that all debris is removed from the pipeline. To this end cleaning and gauging pigs are normally run through the pipeline to ensure the line is clear before the intelligent pig is run.

Constant pig run speed is also critical to the collection of reliable data from intelligent pigging operations. Surging of the pig should be avoided. To this end constant back pressure needs tobe maintained. For pig propulsion a non compressible medium such as seawater is strongly preferred as it is far easier to maintain constant back pressure and speed. Propulsion by Air or Nitrogen should be avoided. Inclusion of the intelligent pig with the pipeline dewatering train should be avoided if possible as surging of the pigs is hard to control. These issues need to be discussed in the project planning phase.

OCS does not own intelligent pigs but has agreements with reputable subcontract companieswho provide the specific intelligent pigs and qualified technicians to support the overall pipeline pre-commissioning operation.

11. PIPELINE HYDROTESTING

Pipeline hydrotesting is normally carried out after the completion of flooding, cleaning andgauging activities. Hydrotesting confirms the strength and leak integrity of the pipeline.

The purpose of the pipeline hydrotest is to ensure that the pipeline, as well as all flanged connections and appurtenances meet or exceed the design specifications. This is done by introducing a pressure typically 125% of the design operating pressure of the pipeline. The pressure is introduced by pumping additional water into the pipeline system, and maintaining the pressure for a minimum of 24 hours, without additional pumping or unaccountable losses.

When the pigging run has been accepted by the Client, the pig launcher and receiver assemblies are removed and blind flanges installed. A pumping spread, comprising a high- pressure pump, chemical injection pump and a flow meter will be set-up adjacent to the end of the pipeline. Additional instrumentation for monitoring the test will also be set-up in a sheltered location nearby. This will normally comprise a dead weight tester, pressure recorders and gauges, subsea temperature monitors, temperature recorders, etc.

The pressure in the pipeline is raised gradually when all the entrapped air in the pipeline is purged. Frequent volume and pressure monitoring is done for the first 30% of the pressure increase to observe for signs of air entrapment. If this is not exceeded, then pumping will continue, otherwise the pressure will be bled off and further purging done to remove the entrapped air.

Stabilization hold points are normally observed at 75% of test pressure, and thence at 100%. The test period will begin when the pressure in the pipeline stabilizes over a reasonable length of time. When the test is deemed to begin, new charts will be placed in allthe recording instruments. Any pressure loss will need to be correlated to temperature fluctuations. When the Client is satisfied that the test is acceptable, after holding for a period of 24 hours or more, then the pressure can be bled off gradually.

Care must be taken when preparing the hydrotest to ensure that all the pipelinecomponents are rated to or above the test pressure. This may be a problem when hydrotest limits extend to process pipe work on topside decks or refinery equipment onshore.

Some of the key points to consider when running the hydrotesting operation are:

- Allow for thermal stabilization before commencement of hydrotest.
- Confirm any valves in the system are not closed.
- Ensure the Pipeline is topped-up with treated seawater from the pressurization end tovent off residual air within the pipeline.
- Air venting provision is provided in temporary manifold system at one or both ends of apipeline.
- Only once system is topped-up and air venting has been completed, pressurization will commenced.
- All the instruments such as Dead Weight Tester, pressure recorder, temperature recorderand pressure gauges are connected to manifold which is installed on test blind.
- The the rate of pressurization at various stages of hydrotest, and stabilization hold points,shall be followed as per client specifications and approved procedures.

12. PIPELINE BULK DEWATERING

Bulk dewatering involves the running of pigs equipped with sealing discs with compressed air to remove the majority of the water in the pipeline. Further runs with polyurethane foampigs will then continue to swab and remove free water from the pipeline. This process also further cleans the internal walls of the pipeline. Strict criteria may exist governing the internal cleanliness of the pipeline that may require the running of many such swabbing pigs.

Dewatering shall not commence until the acceptance criteria for the hydrotest have been met andapproved by the client.

Typically a pipeline will be gauged and dewatered with a pig train consisting of 3 bi-directional dewatering pigs. The pigs will be launched and propelled at an approximate speed of between 0.5m/s to 1.5m/s by dry air until the pigs are received at the receiver.

Ideally a pig indicator is installed on the receivers, to give confirmation that pigs have arrived. If they are not, the indication of pigs arrival will be an increase in back pressure as the pigs reach the receiver, and decrease in back pressure when all the pig has arrived. A second check is the confirmation of volume of air injected into the pipeline.

In the event that it is unsure if the pig is has arrived in the receiver, an additional 10% of fill volume shall be injected. Once the pig train is received the pipeline will be depressurized to ambient, and the pig train will be recovered one by one from the receiver. On acceptance of the pigs condition, all the logs, chart and gauging plates shall to be signed by the parties.

The final stage of dewatering of the pipeline typically utilizes a pig train consisting of 2-3 Long Run Heavy Duty (LRHD) final dewatering and swabbing pigs. As an example, a final dewatering pig train configuration may consist of the following:

- 1 x LRHD bare foam pig
- 100liner meter of dry air at 3barg
- 1 x LRHD bare foam pig
- 100liner meter of dry air at 3barg
- 1 x LRHD bare foam pig
- One line volume at 3barg

13. PIPELINE AIR DRYING

The concept of air drying of a pipeline is based around the principle that a continuous supply of heated air from an air compressor provides heat energy which is absorbed by residual water in the pipeline, which speeds evaporation. The water vapor is transported by the flowing air out of the pig receiver at the other end of the pipeline.

A hygrometer setup at the receiver will indicate completion of the drying process when the outlet air dew point reduces significantly from its starting value. During the pipeline drying process, the air will be close to saturation at the prevalent ambient temperature. When the pipeline is dry, the dew point will reduce towards that of the feed air from the compressor.

In the field, typically pipelines shall be air dried using the same air drier spread used during swabbing operation. The air drying operation commences with 1 line volume after the last foam swabbing pig is removed from receiver. Air is blown continuously until the client specified dew point is reached at the receiver end.

14. PIPELINE VACUUM DRYING

Vacuum drying is a method where the pipeline is completely sealed and then a single port is connected to high power vacuum system, which extracts air from the pipeline. Over a period of time, the humidity level in the outlet will reduce rapidly as a stable vacuum level is formed. There will be a period where the dewpoint level stabilizes as residual liquid water is evaporated and extracted. When all the water has been removed, the dewpoint will drop again and this signals the end of the vacuum purge process. The hygrometer mounted in the vacuum inlet will give determination of the end point.

There are basically 5 steps to the vacuum drying process:

i) Pipeline isolation; pull down to Saturation Vapour Pressure (SVP)
ii) Boil off
iii) Pull down to Partial Vapour Pressure (PVP)
iv) Soak Test
v) Stabilization

As advance preparation for the pipeline drying operation, temporary piping and fittings shall be fabricated for connecting the pipeline end to the Vacuum Equipment.
Prior to commencing the vacuum drying operations on the pipeline section, it is necessary to ensure that all temporary pipe work and all the flange joints are vacuum tight (no leaks under vacuum).

The typical sequence of steps followed during vacuum drying process follows:
The pipeline section valve will be closed and the system pressure from the vacuum pumps to the main pipeline valve will be pulled down

When the pipeline section target pressure has been reached the vacuum pumps will be shut down, the system will be allowed to stabilize. Upon completion of stabilization the pressure will be monitored and logged at 10 minute intervals for a period of 1 hour. If there is no considerable leak in the temporary piping connections the in leak check is accepted if not the connections has to be rechecked properly and corrected to be leak proof.

Upon completion of the temporary piping system in leak checks, the main pipeline section valve shall be opened. The vacuum pumps shall be brought on line (slowly) and the vacuum drying of the pipeline section shall commence.

The pressure in the pipeline section shall be reduced to the Saturation Vapour Pressure (SVP), which upon achieving this pressure the water in the pipeline section will start to boil off.
When all free water in the pipeline section has boiled off, the pressure will start to fall at an accelerated rate, during which stage the absorbed water in the pipe wall will be pulled out.
The pipeline section pressure will then be pulled down to the Partial Vapour Pressure corresponding to the client specified dew point (e.g. 4.015 mbar for □5°C Dew point).
Once the pipeline has been drawn down to the required pressure, the “soak test” shall commence. The vacuum plant will be isolated from the pipeline by closing all isolation valves in the system, and the pressure will now be monitored for duration as specified by the client. .
During pipeline isolation, a stabilization period should be allowed, for both pressure and dew point to reach a state of equilibrium. The pressure and dew point would be monitored over a sufficiently long period, dependent on the pipeline’s length and the environmental conditions, so that if any remaining water evolves, an increase in pressure and to a lesser extent dew point would occur.
The soak test will only be deemed acceptable if over the 12 hour period, the pressure measured remains on, or less than 4.015 mbar, taking into consideration any in□leaks calculated during the pipeline in□leak test.

Upon acceptance of the dryness of the pipeline section the remote location will be isolated and the pipeline pressure reduced to PVP pressure (4.015 mbar or □5o C Dew point). Upon completion of vacuum drying the pipeline will be isolated and left under vacuum ready for nitrogen packing.

15. NITROGEN PURGING AND PACKING

As part of the preparation for the Nitrogen Packing process, once the equipment has been set-up, it shall be function tested in order to ensure that no damage has occurred during transportation to site. All temporary hoses, pipe work, fittings and valves shall be tested to the maximum operating pressure of the units.

The Nitrogen is brought to site as a liquid, contained in a cryogenic tank. During pumping operations the liquid is pumped through a vaporizer unit where it converts to a gas, and then through the temporary discharge line into the pipeline. Pumping rates and pressures are variable to suit the operation required. Nitrogen Gas shall be injected into the pipeline to break the vacuum and line shall be pressurized to 2 Barge.

Nitrogen with the following typical characteristics will be pumped in to the pipeline:

Dew point □50 deg c
Oxygen max 2%
Co2 max 5%

Vacuum Hoses shall be disconnected and suitably rated blind flanges shall be installed.
Delivery hoses from the vaporizer shall be connected to the 2" connection available on the blind flange installed at the end of Pipeline.

The typical sequence of a Nitrogen Packing Operation is as follows:

Open valve on the nitrogen tank allowing liquid nitrogen into the nitrogen vaporizer, maintain the liquid nitrogen tank pressure between 3 to 5 Bar.
Commence flow of liquid nitrogen from the storage tank through the nitrogen vaporiser. As the liquid turns to gas in the vaporizer commence flow to the pipeline.
Nitrogen injection will begin slowly and build to an expected pumping rate of approx. 1000 Cu. Mtrs/Hr.
Continue to flow nitrogen gas into the pipeline, change liquid tank as and when necessary.
Purging will continue until pressure in the pipeline reaches to 2barg. Upon receiving confirmation the required pressure has been achieved, the pumping shall be ceased.
Pressure will be monitored and recoded by pressure chart recorder. On completion of nitrogen purging, readings shall be taken for every 2hrs interval of Pipeline pressure and temperature up to 24hrs

16. EXISTING AND PAST CLIENTS

OCS has built up a significant customer base during fourteen (14) years of operations. OCS past and present clients are listed below. References can be provided on request.

No.	Client Name
1	Asia Petroleum Developments (Salamander) Indonesia)
2	Antares (Singapore)
3	Burmi Armada
4	Chevron (Thailand)
5	Chiyoda Singapore (Pte) Ltd (CSL) (Singapore)
6	EMAS (Singapore)
7	Exxon Mobil Asia Pacific (EM) (Singapore)
8	DOF Subsea Asia Pacific Pte Ltd

No.	Client Name
9	Franklin Offshore (Singapore)
10	Galoc (Philippines)
11	GFI (Thailand)
12	Global Industries (Malaysia)
13	Hako Offshore (Singapore)
14	Heerema (Holland)
15	HESS (Indonesia)
16	Hydropro Pte Ltd (Singapore)
17	Kangean Energy (Indonesia)
18	Larsen & Toubro (Malaysia/ India)
19	Leighton Offshore
20	M3 Energy (Malaysia)
21	Newfield Peninsula Malaysia (Malaysia)
22	Nippon Steel (Indonesia)
23	NorCe (Singapore)
24	NuCoastal (Thailand)
25	Offshore Marine Contractors
26	Origin Energy (Australia)
27	PT Timas Suplindo (Indonesia)
28	SapurasAcergy (Malaysia)
29	Sarku (Malaysia)
30	Sea Drill (Singapore)
31	Shelf Subsea (Singapore)
32	Shell (Singapore)
33	Star Petroleum (Indonesia)
34	Swiber (Singapore)
35	TLO SapuraCrest (Malaysia)
36	Vietsovpetro (VSP) (Vietnam)

17. COMPLETED PROJECTS

Year	Project Title	Client	Pipeline Dia (“)	Length (km)	Scope of Work	Location
2021	18 INCHES PIPELINE SYSTEM LEAKAGE RECTIFICATION WORK SAO VANG - DAI NGUYET (SVDN) GAS PIPELINE PROJECT	Shelf Subsea / PSTC	18-inch NB	23km	Flood, Leak test, Dewatering, Drying and Nitrogen Purging	Vietnam
2020	Nam Con Son 2 Gas Pipeline Project - onshore pipelines and facilities PRE/COMMISSIONING GAS-IN AND PERFORMANCE RUN TEST	Vietsopetro	26” production gas pipeline from Long Hai LFS to GPP2; 30” sale gas pipeline from GPP2 to Phu My GDC	8km 30km	Flood, Clean, Gauge, Hydrotest, Dewatering, Drying and Nitrogen Purging	Vietnam
2020	MERAKES Project	PT Timas Sulpindo / Sapura Energy	i. 2-off shallow water rigid pipeline OD: 18” ii. 2-off deep water rigid pipeline OD: 18”	13.347km 32.91km	Flood, Clean, Gauge, Hydrotest	Balikpapan, Indonesia
2019	MELIWIS Project	PT Timas Sulpindo	10” Gas pipeline	10.73km	Flood, Clean, Gauge, Hydrotest, Dewatering, Drying and Nitrogen Purging	Indonesia
2019	PREMIER OIL NATUNA	PT Timas Sulpindo /	10in Rigid Pipeline GP	40km / 15km	Onshore SOW and (FCGT &	Natuna, Indonesia

Year	Project Title	Client	Pipeline Dia (“)	Length (km)	Scope of Work	Location
	SEA BV - BIGP Project	Premier Oil	– AGX 8in Pipeline Iguana – Bison – PWP		Dewater) for Offshore SOW	
2019	Commissioning Work on TWO x 20" I.D. Submarine Hoses for Bukom SBM Subsea Hose Replacement works	Hydropro PteLtd & Shell Singapore	2 x 20" I.D. Submarine Hoses	200m each hose	Flooding and Leak Testing	Shell Bukom, Singapore
2019	Leak Testingof 4 Length of Manuli Hoses (250mea) in KSB, Malaysia	Antares Energy Solutions	6" Manuli hoses x 4 lengths	250m each hose	Flooding and Leak Testing	KSB, Malaysia
2019	TSB 2 project	PT Timas Sulpindo	26” Pipeline	23.364 km	Flood, Clean, Gauge, Hydrotest and System Leak Test	Indonesia
2019	Pohokura Flowline Section Replacement Project for SHELL TARANAKI Limited	DOF Subsea Asia Pacific Pte Ltd	Flexible 10" (internal diameter 254mm)	750m	Flooding and Leak Testing	Singaporeand New Zealand
2018	Exxon Mobil Asia Pacific Pesek GP II Lubes Storage Project	Chiyoda/ Exxon Mobil	24”	1.02km	Gauge	Jurong Refinery to Pulau Pesek Singapore
2018	Flooding & Testing Svcs Onshore, Singapore	Antares Energy Solutions	2 x 6" Manuli Hoses	220m	Flooding and Leak Testing	Singapore
2018	Antares ES	Antares	6” Manuli	1.25km	Leak testing	Kapal Field

Year	Project Title	Client	Pipeline Dia (“)	Length (km)	Scope of Work	Location
2018	Leak Testing Project	Energy Solutions	Hose			North West Terengganu Malaysia
2017	KH PIPELINE and RISER for Star Energy KG and KH Riser Replacement Project	PT Timas Sulpindo	2 x 10” pipeline from KG and KH platform to the PLEM	11.4KM and 2KM	De-oiling	West Natuna Sea, Indonesia
2017	Pipeline Repair and Replacement Project	PT Timas Sulpindo	10.75" Main oil line, 14" Main Oil Line and 6" Flexible Pipeline	1.6km/30km /2.7km	Flood, Clean, Gauge, Hydrotest	Offshore Indonesia
2017	PTSC Asia Pacific Pte Ltd	DOF Subsea Asia Pacific Pte Ltd	6’, 8” & 10”	6.085 km 6.195 km 2.863 km	Flood, Clean, Gauge, Hydrotest	Lamson Field Vietnam
2017	KSB Malaysia for Coastal KBM (PMT, Function Test)	Antares Energy Solutions Pte Ltd	6” Manuli Hose	-	Leak testing	Banang Field
2017	PT Pertamina Hulu Energi Offshore North West Java	PT Timas Sulpindo	10” & 14”	3.662 km /27.121km	Flood, Clean, Gauge, Hydrotest	PT Pertamina Hulu Energi North West Java Offshore
2017	HCML	PT Timas Sulpindo	14” & 20”	3.662 km /27.121km	Flood, Clean, Gauge, Hydrotest	HCML
2016	Star Energy Project	PT Timas Sulpindo	6.625”	6.75m	Flood, Clean, Gauge, Hydrotest	Star Energy Project Field
2016	PHE WMO Project	PT Timas Sulpindo	6.625”	12km	Flood, Clean, Gauge, Hydrotest	Syrabaya PHE WMO field

Year	Project Title	Client	Pipeline Dia (“)	Length (km)	Scope of Work	Location
2015	Bekapai Phase 2BEPSC2 Project	Total Indonesia	12”	12.5km	Hydrotesting, Intelligent pigging, Dewatering, Drying and N2 Packing	Bekapai field, Indonesia
2015	Tembikai Oil Field Development Project	Vestigo Petrolium / Antares	6” Manuli Flexible Flowline import hose	250m	Leak Testing	Tembikai, Malaysia
2015	Shell Malikai	Shell / Technip	Leak testing for 10” and 8” spools and installation aids	-	Leak Testing	Malikai field, Malaysia
2014	PTSC STV South West Project	Bumi Armada	6” & 10”	7.5 each	Flood, Clean, Gauge, Hydrotest	Su Tu Field of Block 15-1, offshore Vietnam
2014	Coastal KBM Project Phase 2	Antares Energy Solution	6”	750m	Flood, Clean, Gauge, Leak test, Dewater	Offshore Terengganu, Malaysia
2014	DOF Lamson FPSO Flowlines	DOF / LAMSON	6”,8”, 10 & 12"	1km - 2.5km	Flooding, Back-seal testing, Leak Testing, Dewatering, N2 packing	Thang Long / Dong Do Field, Vietnam
2014	Petronas Ketapang	PT Timas Sulpindo	8”, 12” & 16”	700 m each	Flood, Clean, Gauge, Hydrotest	Offshore Indonesia East Java Sea
2014	Petronas Ketapang	PT Timas Sulpindo	12”	111	Flood, Clean, Gauge, Hydrotest, Dewater, Dry, N2 Pack.	Offshore Indonesia East Java Sea
2013	Pertamina EP L-Parigi	PT Timas Sulpindo	14” & 20”	500m & 3.3 km	Flood, Clean, Gauge, Hydrotest	Java Sea
2013	Pertamina UL Project	PT Timas Sulpindo	12”	12	Flood, Clean, Gauge and Hydrotest	Java Sea

Year	Project Title	Client	Pipeline Dia (“)	Length (km)	Scope of Work	Location
2013	PTSC Su Tu Field Development Project	Bumi Armada	6” & 8”	7.5 each	Flood, Clean, Gauge, Hydrotest	Su Tu Field of Block 15-1, offshore Vietnam
2013	PertaminaEP MOL Project	Leighton Offshore	12”	28	Flood, Clean, Gauge, Hydrotest and Dewater	Java Sea
2013	Coastal KBM Project Phase 1	Antares Energy Solution	6”	750m	Flood, Clean, Gauge, Leak test, Dewater	Offshore Terengganu, Malaysia
2013	PTTEP Bongkot Riser Replacement	DOF Subsea	6”	80m	Leak Test	Gulf of Thailand
2013	Zawtika	L&T	18” 18”	11.3 9.7	Flood, Clean, Gauge and Hydrotest	Myanmar
2012	Bien Dong	DOF Subsea	6” flexible	400m	Leak Test	Vietnam
2012	Bawal	PT Timas Sulpindo	14”	40	Flood, Clean, Gauge and Hydrotest	Natuna Sea
2011	TSB Kangean	PT Timas Sulpindo	18”& 20”	25.745 & 5.2	Flood, Clean, Gauge and Hydrotest, Dewater, Dry and Nitrogen Packing	Java Sea
2011	Chevron (Thailand)	EMAS	10” 16”	35 35	Flood, Clean, Gauge and Hydrotest	Gulf of Thailand
2011	Kodeco Project	PT Timas Sulpindo	6”	7 & 6	Flood, Clean, Gauge and Hydrotest	Java Sea
2011	Kangean Energy Indonesia Limited – TSB Development	PT Timas	18” 20” 20”	25 5.5 5.5	Flood, Clean, Gauge & Hydrotest, Dewater, Dry & Nitrogen Packing	Bali Sea, approximatel y 120km from Pagerubgan Island

Year	Project Title	Client	Pipeline Dia (“)	Length (km)	Scope of Work	Location
2010	HESS Ujung Pangkah Development	PT Timas Sulpindo	6” 12” 16”	5.5 5.5 5.5	Flood, Clean, Gauge, Hydrotest, Dewater, Air & Vacuum Dry and Nitrogen Packing	Ujung Pangkah, Gresik in Surabaya Indonesia
2009	M3nergy JDA	Franklin	11” Flexible	0.24	Leak Test	Offshore
	Sdn Bhd/ Carigali-PTTEPI-JDA Block B-17	Offshore				Malaysia
2009	Star Petroleum Kakap Field Redevelopment	PT Timas Sulpindo	10” 6” 6”	11.2 2 2.3	Flood, Clean, Gauge and Hydrotest	Kakap Field located in the Indonesian West Natuna Sea
2009	Asia Petroleum Development (APD) – Glagah Kambuna Field Development	PT Timas Sulpindo	14 “	42	Flood, Clean, Gauge and Hydrotest	From the Kambuna platform offshore North Sumatera toa landfall Northeast of Medan
2008	Nexus Australia-Bass Strait	Nexus	PLEM & Startup Heads	-	Leak Test	Singapore
2008	Galoc Development Project	EOCP EMAS offshore Construction and Production	6“ Spool 6” Flexible	0.7	Leak Test	65km off North West Coast of PalawanIsland
2007	GFI	EOCP EMAS offshore Construction and Production	10” 6” Flexible	0.8 0.1	Flood, Clean, Gauge and Hydrotest/Leak test	Gulf of Thailand

17.1 PROJECT PHOTOS

Sao Vang -Dai Nguyet (SVDN) Gas Pipeline Project, 2021
Pigging, Hydrotest, Drying Photos

Merakes Project, 2020
Pigging & Hydrotest Photos

Meliwis Project, 2019
Dewatering & Drying Photos

BIGP Project, 2019
FCG, Baseline Intelligent Pigging & Hydrotest Photos

Zawtika Project, 2013
Pigging & Hydrotest Photos

Kodeco Project (Oct - Dec 2011)
Pigging & Hydrotest

Kangean Project (Aug- Nov 2011)
Pigging, Hydrotest, Dewatering, Air drying and N2 packing

HESS (UJUNG PANGKAH) Pipeline Project (Jan – Feb 2010)
Pigging, Hydrotest, Dewatering, Drying & N2 Pack

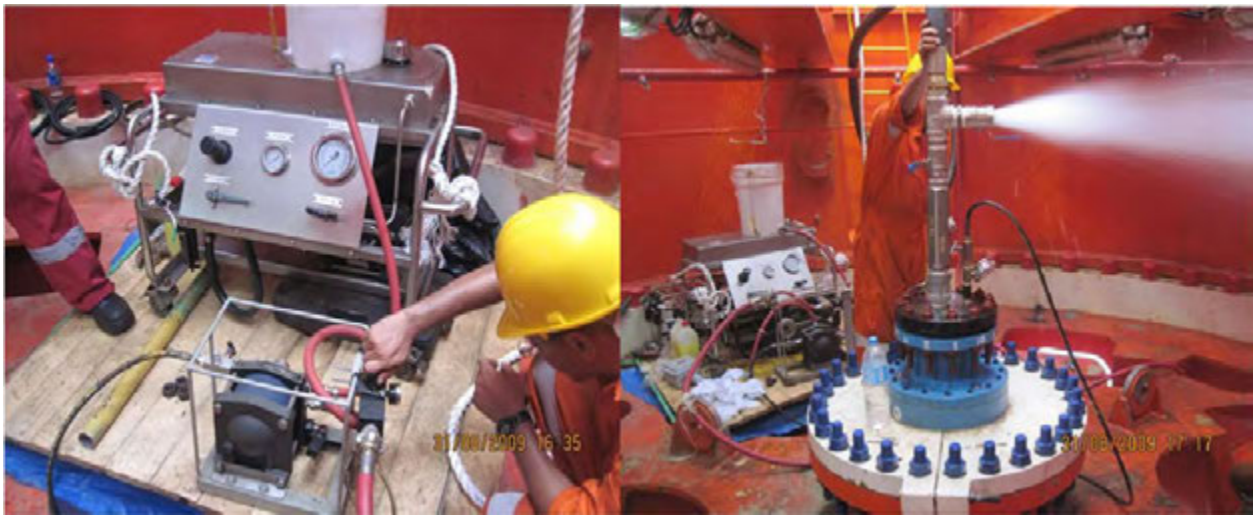
Chevron Thailand Project (Jan – July 2010)
Rgging & Hydrotest Photos

GFI (Thailand) (Nov 2007 to Jan 2008) Pigging and Hydrotesting

Asia Petroleum Development (APD) Pigging and Hydrotesting (Mar 2009)

Glagah Kambuna Field Development Project

Flexible Riser Leak for M3nergy JDA Sdn Bhd / Carigali-PTTEPI (Sep 2009)
JDA Block B-17, Offshore Malaysia



Star Energy (KAKAP) Pipeline Project (Oct 2009)
Pigging & Hydrotest

18. EQUIPMENT DATA SHEETS

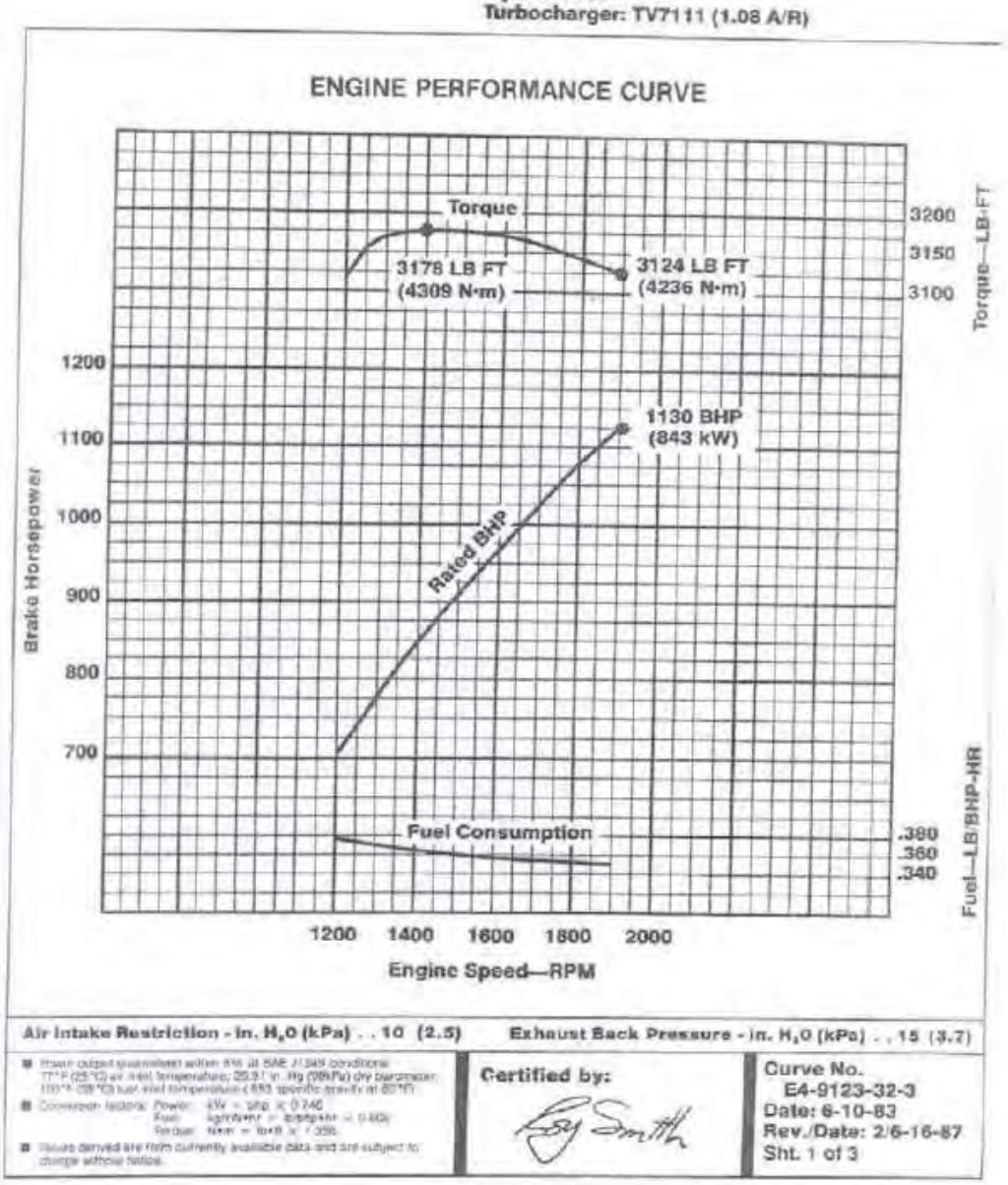
OCS operates a comprehensive range of pre-commissioning equipment. Each piece of equipment has its own equipment passport which is maintained from project to project. This helpsensure that only appropriately maintained equipment is supplied to projects.

18.1 UNION MULTISTAGE (5-STAGE) CENTRIFUGAL PUMP

UNION 5-STAGE PUMP (FLOODING PUMP)	- 04Nos.
Flow Rating	443 m3/hr; Head: 412m @2732 RPM
Maximum Head	412m
Power Train	Detroit Diesel 12V-149TI 1130BHP Engine
Fluid End	6 x 10 MFQ 5-Stages Centrifugal Pump

DETROIT DIESEL CORPORATION

12V-149TI
Industrial
Rated BHP
1130 BHP @ 1900 RPM
3178 LB-FT @ 1400 RPM
Injector: 150
Turbocharger: TV7111 (1.08 A/R)

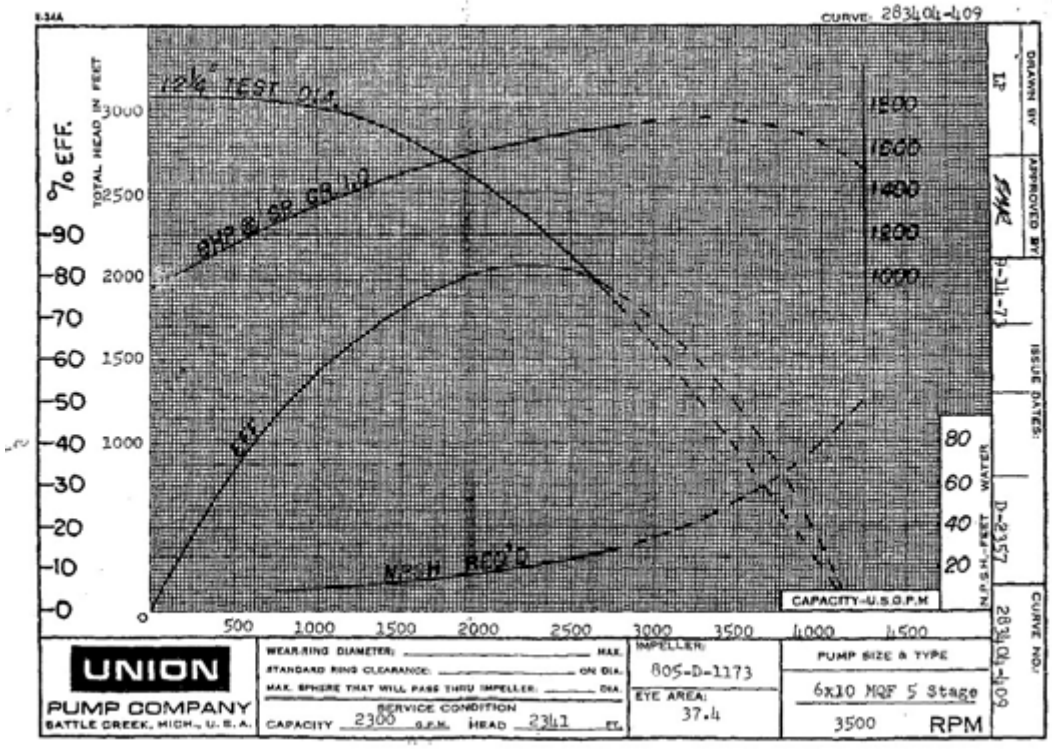


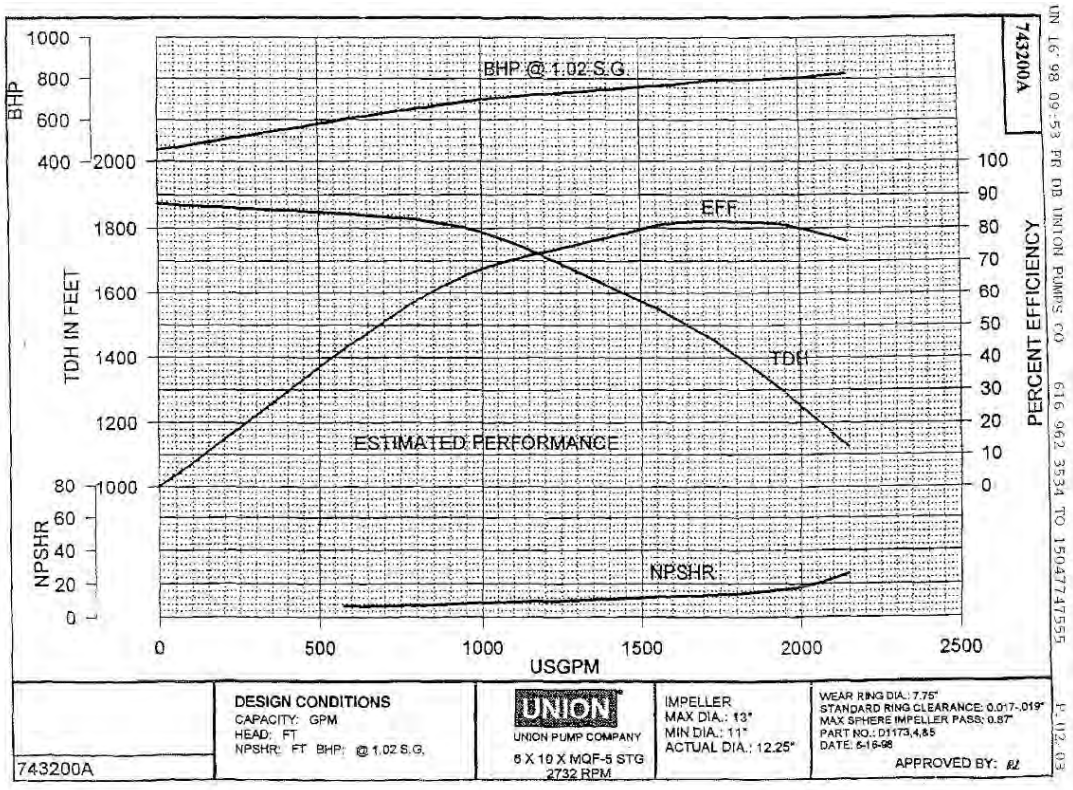
Air Intake Restriction - in. H_2O (kPa) . . 10 (2.5) Exhaust Back Pressure - in. H_2O (kPa) . . 15 (3.7)

- Power output guaranteed within 5% at SAE J1349 conditions
- Conversion factors:
- Values derived are from currently available data and are subject to change without notice.

Certified by:

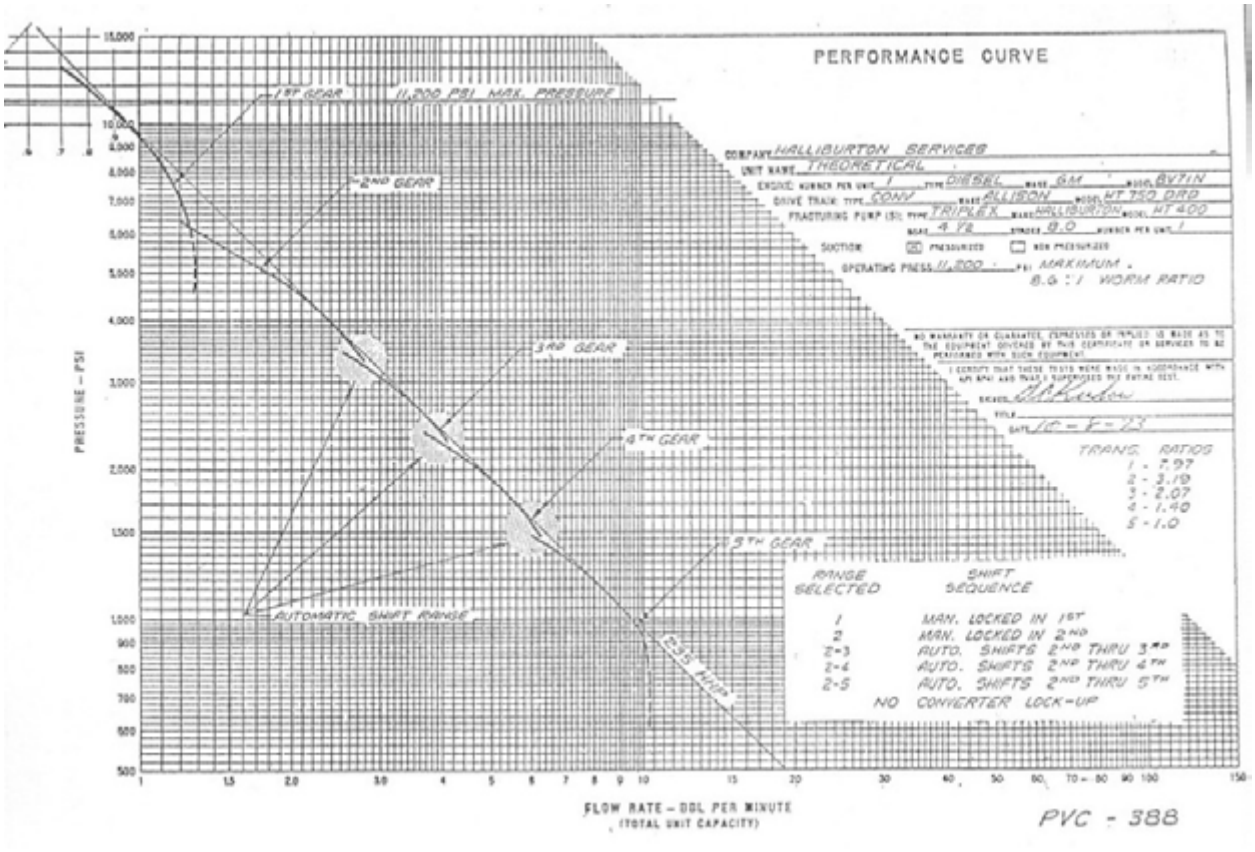
Curve No.
E4-9123-32-3
Date: 6-10-83
Rev./Date: 2/6-16-87
Sht. 1 of 3


CURVE: 283404-409
12¼" TEST DIA
BHP @ SP GR 1.0
EFF
NPSH REQ'D
% EFF.
TOTAL HEAD IN FEET
CAPACITY-U.S.G.P.M
UNION
PUMP COMPANY
BATTLE CREEK, MICH., U. S. A.
SERVICE CONDITION
CAPACITY 2300 G.P.M. HEAD 2341 FT.
IMPELLER: 805-D-1173
EYE AREA: 37.4
PUMP SIZE & TYPE
6x10 MQF 5 Stage
3500 RPM
CURVE NO. 283404-409
ISSUE DATE: 8-11-77
APPROVED BY:
DRAWN BY: EJ
D-2157


743200A
BHP @ 1.02 S.G.
EFF
TDH
ESTIMATED PERFORMANCE
NPSHR
BHP
TDH IN FEET
NPSHR
PERCENT EFFICIENCY
USGPM
DESIGN CONDITIONS
CAPACITY: GPM
HEAD: FT
NPSHR: FT BHP: @ 1.02 S.G.
UNION
UNION PUMP COMPANY
6 X 10 X MQF-5 STG
2732 RPM
IMPELLER
MAX DIA.: 13"
MIN DIA.: 11"
ACTUAL DIA.: 12.25"
WEAR RING DIA.: 7.75"
STANDARD RING CLEARANCE: 0.017-.019"
MAX SPHERE IMPELLER PASS: 0.87"
PART NO.: D1173,4,&5
DATE: 5-16-98
APPROVED BY:
743200A
JUN 16' 98 09:53 FR UNION PUMPS CO 616 962 3534 TO 15047475555 P.02/03

18.2 HT400 HIGH PRESSURE POSITIVE DISPLACEMENT PUMP

HALLIBURTON HT 400 (HYDROTEST PUMP)	- 01Nos.
Flow Rating	200gpm @2000psig
Max. Pressure	11,200 psig
Power Train	GM 8VA-71 N Series Diesel Engine
Fluid End	EW 064 Triplex Positive Displacement Pump

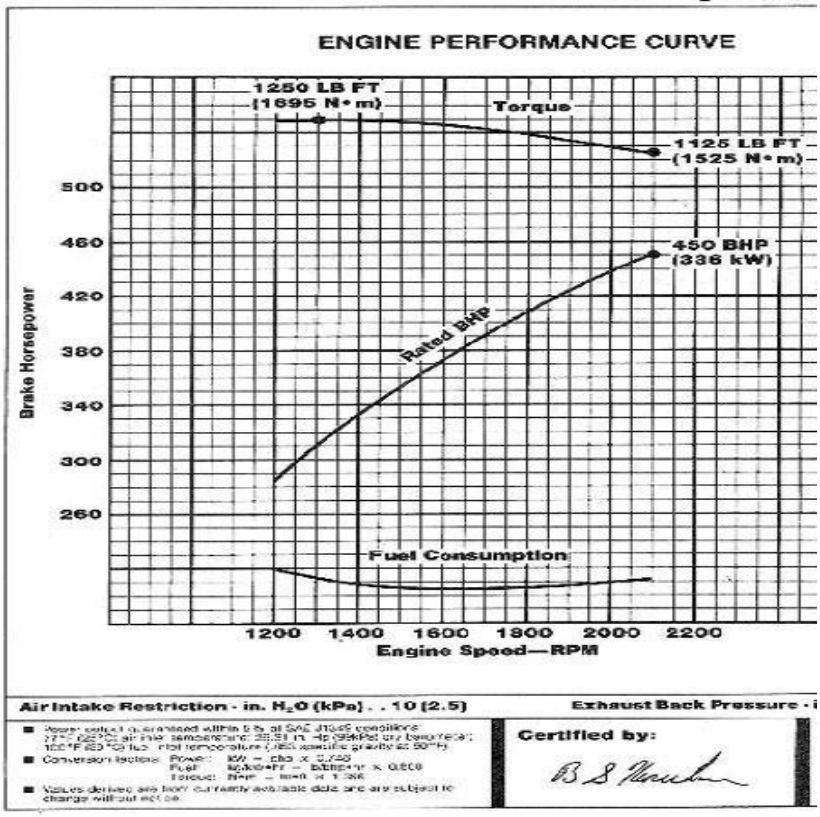


18.3 3-STAGE DIESEL DRIVEN CENTRIFUGAL PUMP

3-STAGE CENTRIFUGAL (FLOODING PUMP)	- 05 Nos.
Flow Rating	320 m^3/hr; Head: 171m
Fluid End	200SLD280-43x3
Power Train	Detroit Diesel 8V-92TA 450BHP

DETROIT DIESEL CORPORATION

8V-92TA
Industrial
Rated BHP
450 BHP @ 2100 RPM
1250 LB-FT @ 1300 RI
Injector: 9G85
Turbocharger: TV851



水泵检测数据表

水泵编号Number: 01

(PUMP INSPECTION REPORT)

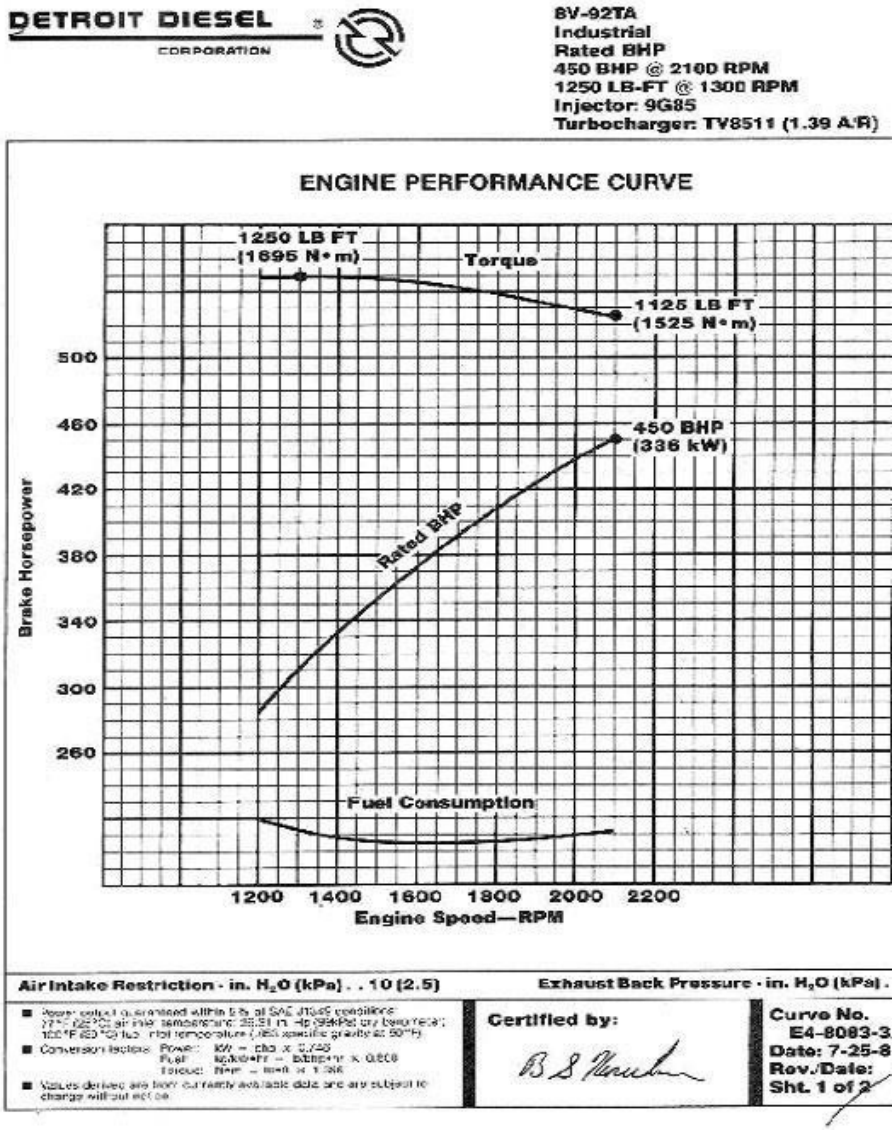
水泵型号 type pump	200SLD280-43*3	流量（m^3/h） Capacity	321	功率（kW）Power	286
泵效率Pump Eff(%)	70.0%	扬程（m）Head	170	转速（r/min） Speed	1700
序号NO	流量 Capacity（m^3/h）	扬程 Head （m）	轴功率 Driver shaft power(kw)	泵效 Pump Eff(%)	换算至额定转速 transfor to rating speed
1	0.00	207.84	147.22	0.0	
2	160.51	195.78	167.01	51.2	
3	272.31	182.32	196.55	68.8	
4	321.31	170.59	212.77	70.2	
5	384.52	149.05	231.75	67.3	

结论： 合格 **测试：** 胡学刚 **日期：** 2008年11月

Conclusion: conformity testing: HXG **date:** Nov-08

18.4 FEED PUMP (SLOW FLUID END)

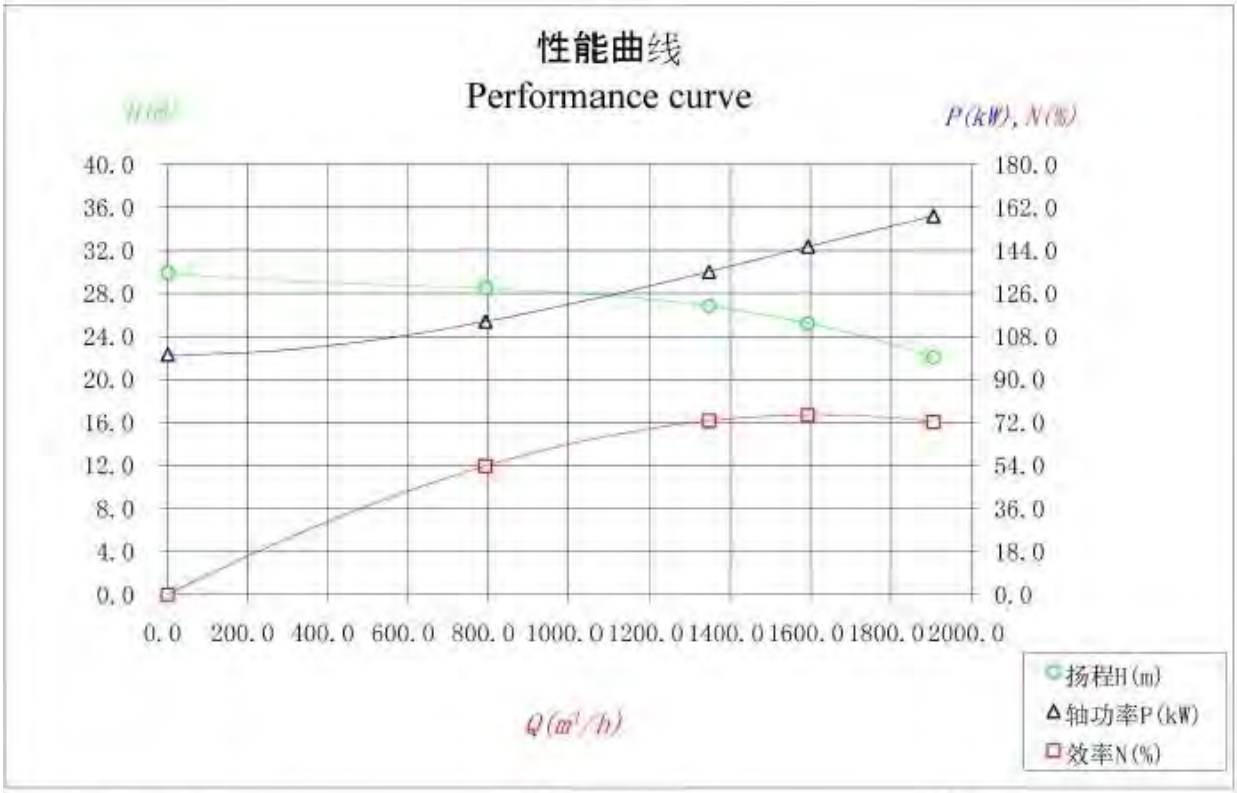
FLOODING PUMP	- 03 Nos.
Flow Rating	1590 m^3/hr; Head: 25m @1800 RPM
Engine Make	Detroit Diesel 8V-92TA 450BHP
Pump Make	SLOW 350-380B



水泵检测数据表 水泵编号Number:

(PUMP INSPECTION REPORT)

水泵型号type pump	SL0W350-380B	流量（m^3/h）Capacity	1590	功率（kW）Power	174
泵效率Pump Eff(%)	75.0%	扬程（m）Head	25	转速（r/min）Speed	1800
序号NO	流量 Capacity（m^3/h）	扬程 Head（m）	轴功率 Driver shaft power(kw)	泵效 Pump Eff(%)	
1	0.0	29.91	100.48	0.0	换算至额定转速 transfor to rating speed
2	792.5	28.46	114.24	53.8	
3	1345.6	26.81	135.05	72.7	
4	1592.2	25.22	145.58	75.1	
5	1905.2	22.05	158.28	72.3	



结论： 合格 测试： 胡学刚 日期： 2010年1月

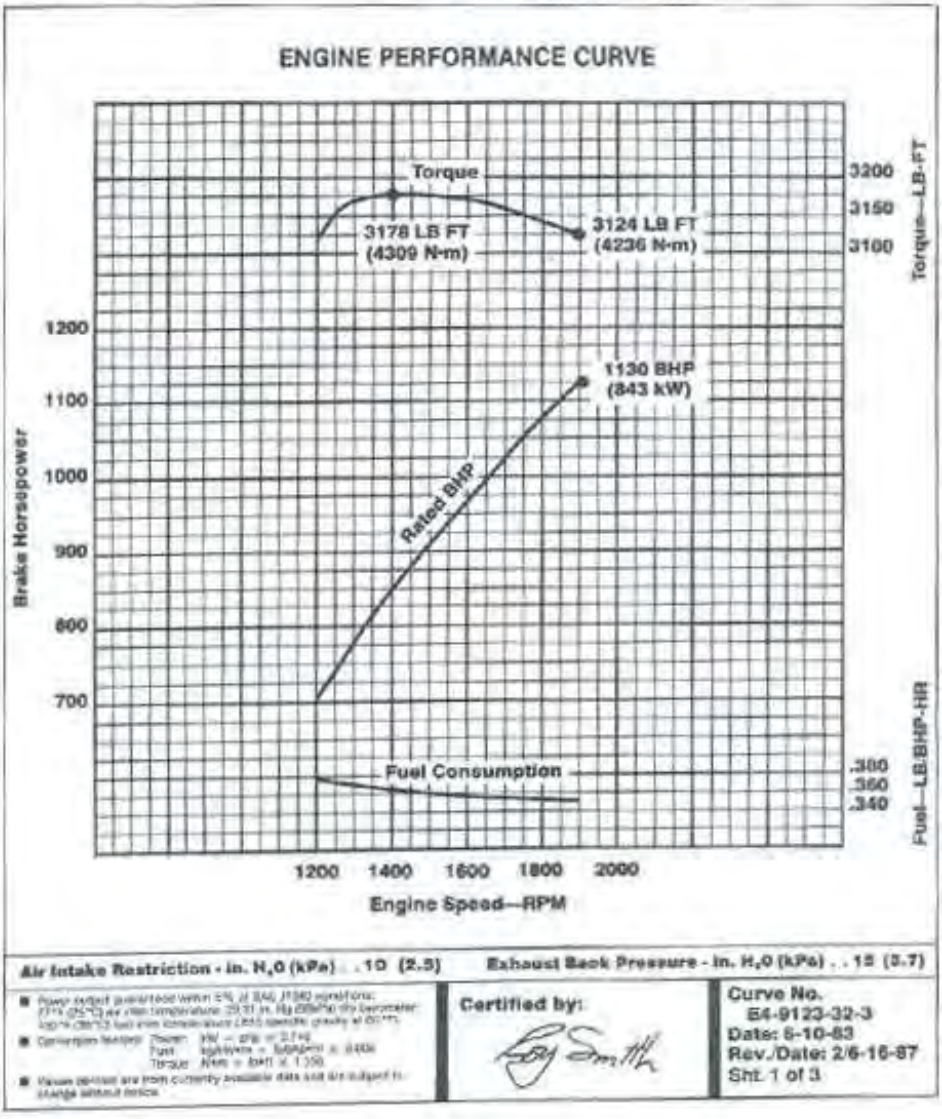
Conclusion: conformity testing: HXG date: Jan/10

18.5 4-STAGE DIESEL DRIVEN CENTRIFUGAL PUMP

FLOODING PUMP	- 03 Nos.
Flow Rating	429m^3/hr; Head: 420m @1900 RPM
Power Train	Detroit Diesel 12V-149TI 1130BHP
Fluid End	250SLD 450-60x4

DETROIT DIESEL CORPORATION

12V-149TI
Industrial
Rated BHP
1130 BHP @ 1900 RPM
3178 LB-FT @ 1400 RPM
Injector: 150
Turbocharger: TV7111 (1.08 A/R)



Air Intake Restriction - in. H_2O (kPa) . . 10 (2.5) Exhaust Back Pressure - in. H_2O (kPa) . . 15 (3.7)

Certified by:

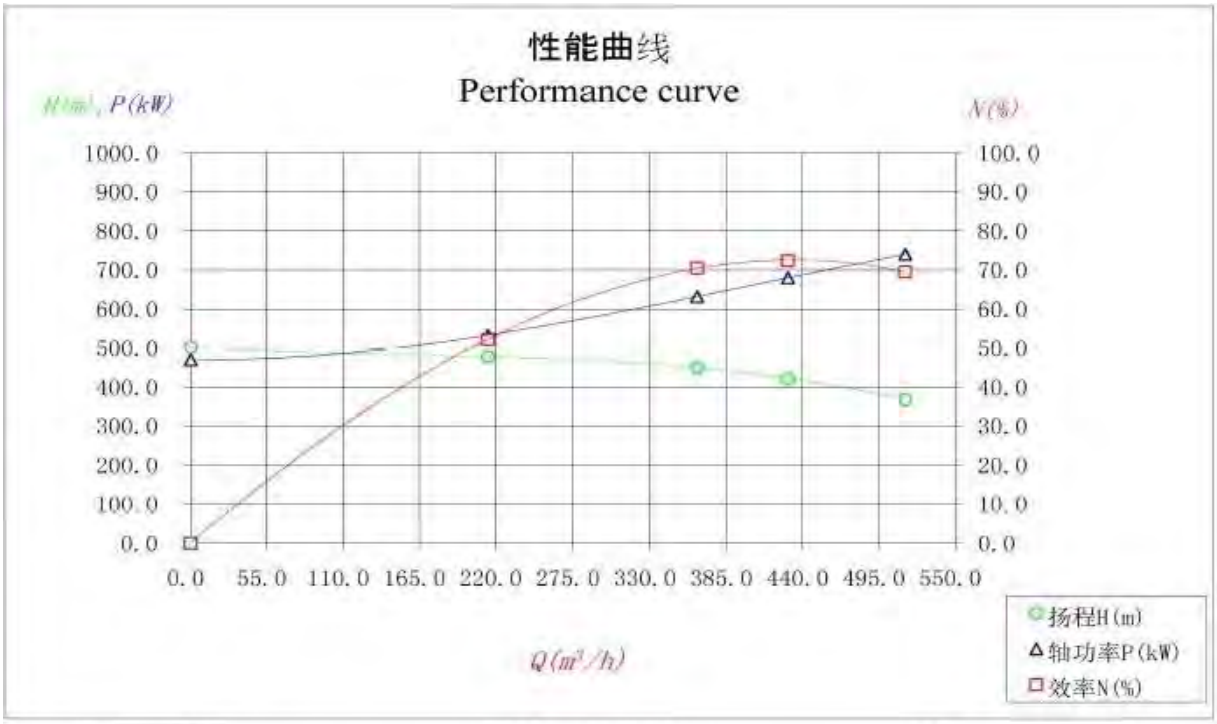
Curve No. 64-9123-32-3
Date: 6-10-83
Rev./Date: 2/6-16-87
Sht. 1 of 3

水泵检测数据表

水泵编号Number:

(PUMP INSPECTION REPORT)

水泵型号type pump	250SLD450-60*4	流量（m^3/h）Capacity	429	功率（kW）Power	843
泵效率Pump Eff(%)	72.0%	扬程（m）Head	420	转速（r/min）Speed	1900
序号NO	流量 Capacity（m^3/h）	扬程 Head （m）	轴功率 Driver shaft power(kw)	泵效 Pump Eff(%)	
1	0.00	501.95	470.07	0.0	换算至额定转速 transfor to rating speed
2	214.44	477.06	533.17	52.3	
3	363.83	449.74	631.76	70.5	
4	429.29	420.91	679.87	72.4	
5	513.83	367.60	739.81	69.5	

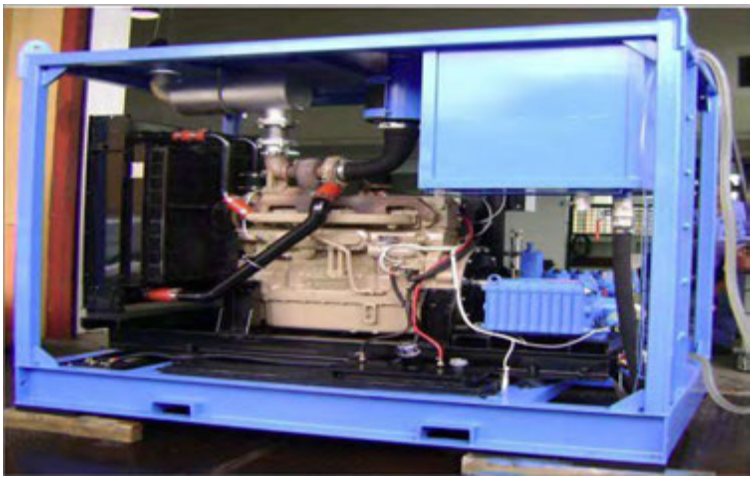


结论： 合格　　测试： 胡学刚　　日期： 2010年1月

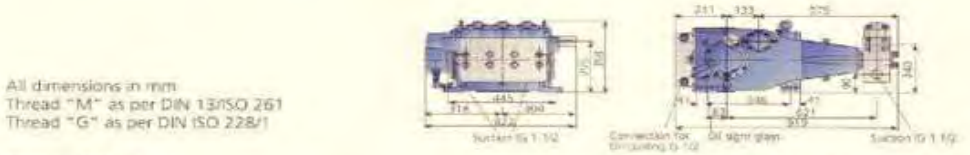
Conclusion: conformity　　testing: HXG　　date: Jan/10

18.6 WOMA HIGH PRESSURE POSITIVE DISPLACEMENT PUMP

WOMA HIGH PRESSURE DIESEL DRIVEN PUMP	- 01 Nos.
Flow Rating	180 liters / Minute @504 RPM
Maximum Pressure	7250 psig
Power Train	Johndeere 160kw 6 cylinder diesel engine
Fluid End	Woma 2502 P40



High-Pressure Plunger Pump Type 2502

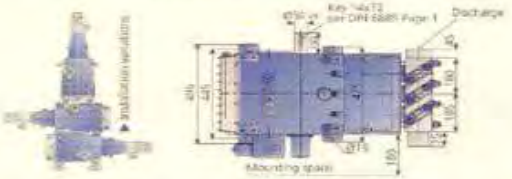


All dimensions in mm
Thread "M" as per DIN 13/ISO 261
Thread "G" as per DIN ISO 228/1

Technical Data:

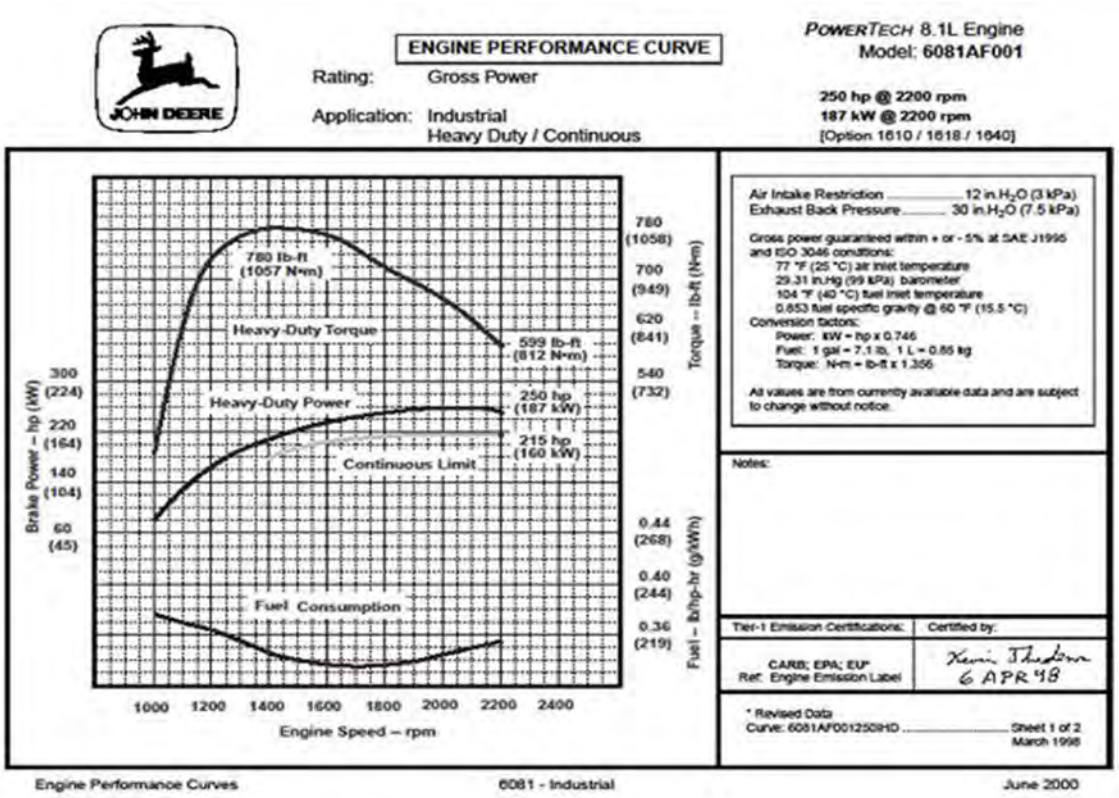
- Oil capacity: approx. 8 l
- Weight: approx. 350 kg net
- Stroke: 95 mm/3.74
- Inlet pressure required*: from P 40: 2 bar/30 psi
- Rod force: 70 kN

* Depends on operating mode, crank shaft speed and water temperature



Performance Chart Pump Type 2502

Plunger-diameter (mm)	Gear ratio: Pinion shaft (Rpm) 1,500	1,800	2,100	Crank shaft (Rpm)	Required drive (kW)	Nominal flow rate: USG (pm)	IMPG (pm)	(l/min)	Maximum permissible operating pressure (psi/bar)
P 30	3.04 3.57 4.52	3.57 4.52	4.52	494 504 398 433 420 331	120 120 103 127 108 85	24.0 26.2 20.6 25.4 21.7 17.2	20.0 21.8 17.2 21.1 18.0 14.3	91 99 78 96 82 65	10,875/750
P 33	3.04 3.57 4.52	3.57 4.52	4.52	464 504 398 433 420 331	143 165 122 152 139 102	32.8 35.4 28.0 34.9 29.6 23.3	27.3 29.5 23.3 29.0 24.6 19.4	124 134 106 132 112 88	9,425/650
P 40	3.04 3.57 4.52	3.57 4.52	4.52	464 504 398 433 420 331	186 158 158 155 132 104	42.9 47.6 37.5 46.5 39.6 31.2	35.5 39.6 31.2 38.7 33.0 26.0	162 180 142 176 150 118	7,250/500
P 45	3.04 3.57 4.52	3.57 4.52	4.52	464 504 398 433 420 331	149 162 128 138 135 106	55.5 60.2 47.6 58.9 50.2 39.6	46.2 50.2 39.6 49.1 41.8 33.0	210 228 180 223 190 150	5,802/400

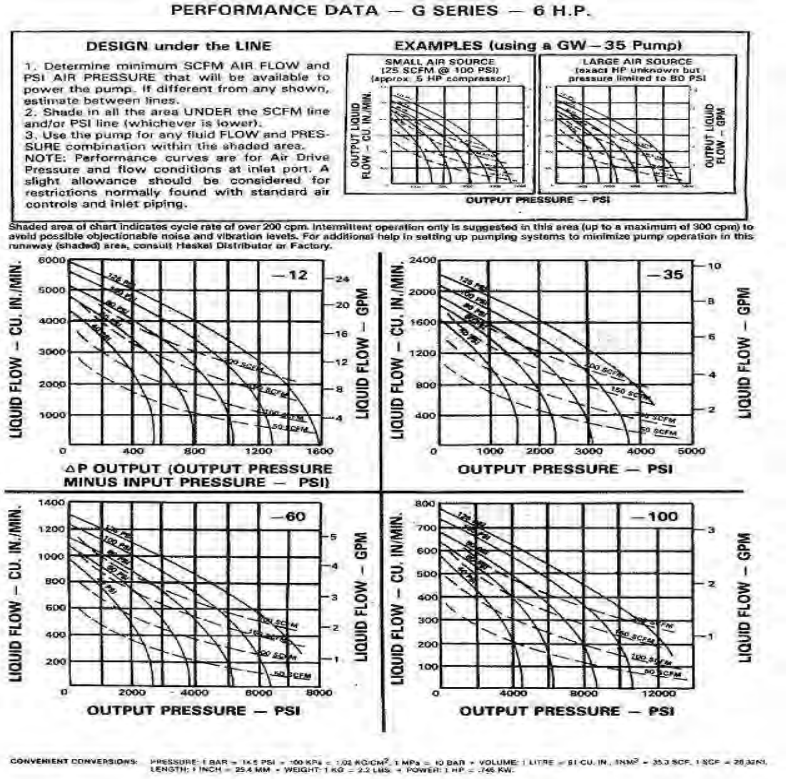


18.7 DENJET HIGH PRESSURE POSITIVE DISPLACEMENT PUMP

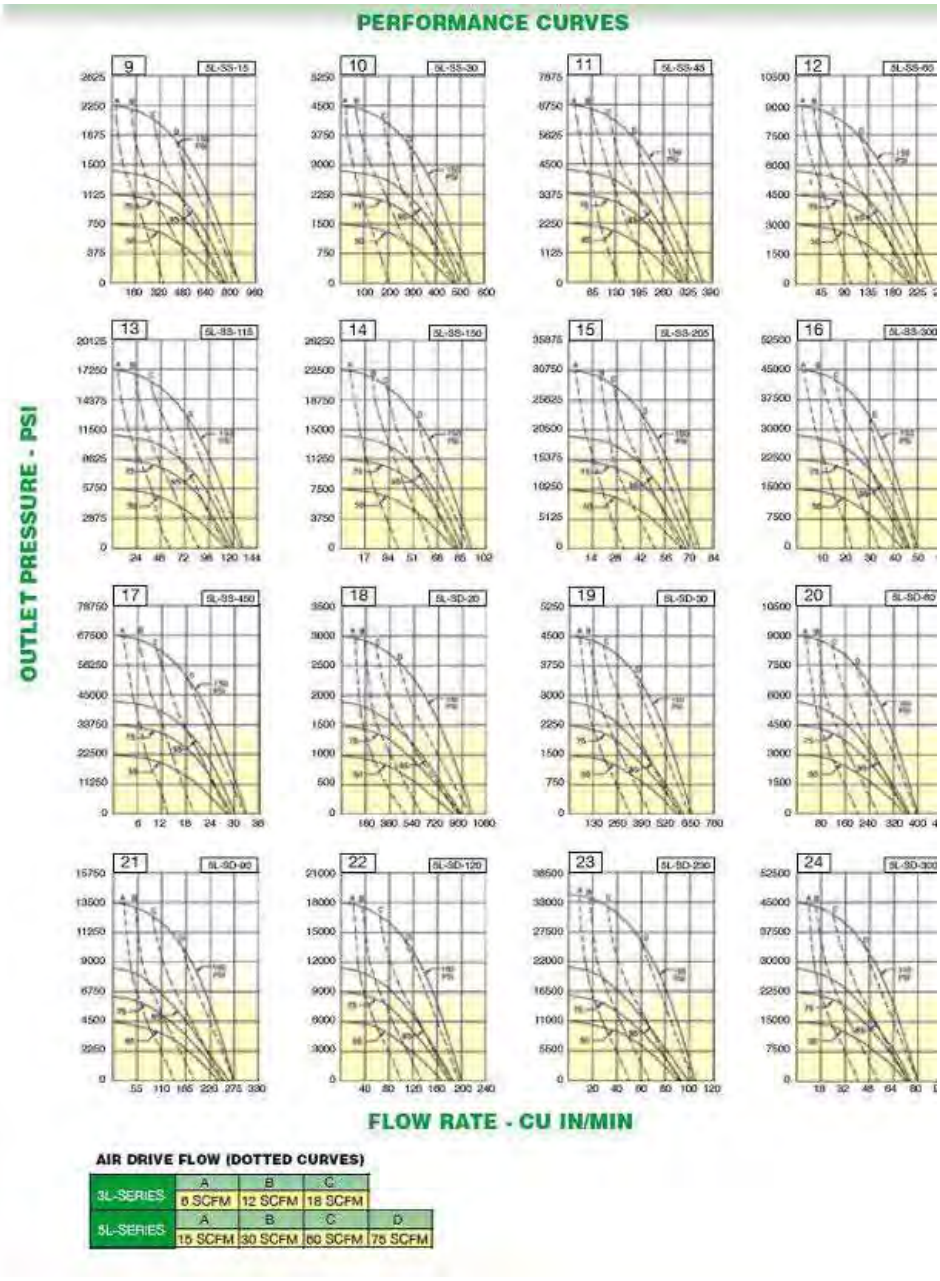
WOMA HIGH PRESSURE DIESEL DRIVEN PUMP	- 01 Nos.
Flow Rating	35-37 liters / minute
Maximum Pressure	8000 psig
Power Train	Isuzu 50HP 4 Cylinder
Fluid End	CD50-550

18.8 HIGH PRESSURE AIR DRIVEN PUMP

HASKEL HIGH PRESSURE AIR DRIVENPUMP	- 02 Nos.
Flow Rate	20 liters / Minute
Maximum Pressure	7,500 psig
Maximum Air Supply Pressure	125 psig
Fluid End	Haskel Model TP600-GSF-60


PERFORMANCE DATA — G SERIES — 6 H.P.
DESIGN under the LINE
1. Determine minimum SCFM AIR FLOW and PSI AIR PRESSURE that will be available to power the pump. If different from any shown, estimate between lines.
2. Shade in all the area UNDER the SCFM line and/or PSI line (whichever is lower).
3. Use the pump for any fluid FLOW and PRESSURE combination within the shaded area.
NOTE: Performance curves are for Air Drive Pressure and flow conditions at inlet port. A slight allowance should be considered for restrictions normally found with standard air controls and inlet piping.
EXAMPLES (using a GW—35 Pump)
SMALL AIR SOURCE
(25 SCFM @ 100 PSI)
(approx. 5 HP compressor)
LARGE AIR SOURCE
(exact HP unknown but pressure limited to 80 PSI
OUTPUT LIQUID FLOW — CU. IN./MIN.
OUTPUT LIQUID FLOW — GPM
OUTPUT PRESSURE — PSI
Shaded area of chart indicates cycle rate of over 200 cpm. Intermittent operation only is suggested in this area (up to a maximum of 300 cpm) to avoid possible objectionable noise and vibration levels. For additional help in setting up pumping systems to minimize pump operation in this runaway (shaded) area, consult Haskel Distributor or Factory.
—12
LIQUID FLOW — CU. IN./MIN.
LIQUID FLOW — GPM
ΔP OUTPUT (OUTPUT PRESSURE MINUS INPUT PRESSURE — PSI)
—35
OUTPUT PRESSURE — PSI
—60
OUTPUT PRESSURE — PSI
—100
OUTPUT PRESSURE — PSI
CONVERIENT CONVERSIONS: PRESSURE: 1 BAR = 14.5 PSI = 100 KPa = 1.02 KG/CM², 1 MPa = 10 BAR • VOLUME: 1 LITRE = 61 CU. IN., 1M³ = 35.3 SCF, 1 SCF = 28.32 LT.
LENGTH: 1 INCH = 25.4 MM • WEIGHT: 1 KG = 2.2 LBS. • POWER: 1 HP = .745 KW.

PH HIGH PRESSURE AIR DRIVEN PUMP	- 04 Nos.
Capacity	2.44 litres/min
Maximum Pressure	6750 psig
Maximum Air Supply Pressure	120 psig
Pump Make	Hydraulics International HI Model 5L-SS-60



18.9 DEAD WEIGHT TESTER

DEAD WEIGHT TESTER + WEIGHT SET	- 02 Set.
Make	DH –BUDENBERG MODEL 580 DX
Range	0-700 bar
Accuracy	0.025 %
Least Count	0.069 bar

18.10 PRESSURE / TEMPERATURE CHART RECORDER

PRESSURE RECORDER	- 03 Nos.
Make	BARTON
Range	0-5000 psi
Accuracy	± 1 % FS
TEMPERATURE RECORDER	**- 02 Nos.**
Make	SCOTECH
Range	0-50o C
Accuracy	± 1 % FS
PRESSURE-TEMPERATURE DUAL RECORDER	**- 02 Nos.**
Make	BARTON
Range	0-5000 psi/0-100o C
Accuracy	± 1 % FS

18.11 8 X 10 FT BREAK TANK (18 CUM. M CAPACITY) - 01 NOS

For storage and introducing freshwater slug during pigging/ dewatering of pipelines

18.12 VACUUM PUMP

VACUUM PUMP	- 01 Nos.
Capacity	1020 Cu.m / Hr
Booster Make	Edwards mechanical booster Model EH1200, Hydrokinetic Drive
Pump Make	Edwards high vacuum pump Serial 220. EIM 275

18.13 PRESSURE TRANSDUCER & READOUT)

	- 03 Nos.
Type	750C, ABSOLUTE PRESSURE TRANSDUCER
Make/ Range	MKS
Accuracy/ Input/ Output	10 MILLIBAR , 100 MILLIBAR , 1000 MILLIBAR 1% OF FULL SCALE +13 TO +32 VDCINPUT, 0-10VDC O/P
	- 02 Nos.
Type	DIGITAL SUPPLY AND READOUT
Make/ Range	MKS
Input Power	220VAC

18.14 HEATED REGENERATIVE DESICCANT AIR DRYER & AIR COOLED AFTER COOLER

AIR DRYER	- 02Nos.
Air Handling Capacity	3000cfm – Continuous Flow
Max. Working Pressure	435psig (30barg)
Max. Dew Point	-70°C
Outlet Dew Point Meter	Mitchell EA-TX-100 (Calibrated Range -70 DP

AIR COOLER	- 02Nos.
Air Handling Capacity	3000cfm – Continuous Flow
Max. Working Pressure	435psig (30barg)
Aftercooler Performance	Reduction of Temperature from 80°C to 40°C
Power Requirements	220VAC, 50Hz

18.15 LIQUID N^2 CONVERTER

1. Operating parameters:
   - Design temperature load bearing/pressure retaining –20 Deg to + 50 Deg C.
   - Design temperature machinery –20 Deg to + 50 Deg C.
2. Diesel Engine
   - Detroit Diesel model 8V 71T
   - Rated to produce 420 BHP @ 2100 RPM. (Continuous)

3.. Gearbox
   - Marco 3 pad hydraulic pump drive gearbox
   - Marco Gearbox will be enclosed coupled on engine flywheel

4. Start System
   - Air starter

5 . Hydraulic System
   - Twin Commercial hydraulic pumps for Low and High pumping rate, motors and relief valves.
   - heat exchanger.

6. Cryogenic High Pressure System
   - Paul triplex.
   - Max. Pressure: 10,000 psi.
   - Flow Rate: 3,000 SCFM.
   - Discharge Temperature: 70°F.

7. Control Panel
   - A stainless steel control panel

8. Skid/Frame

19. ISO CERTIFICATION

UNITED REGISTRAR OF SYSTEMS
URS

Certificate of Registration

This certificate has been awarded to

Offshore Construction Specialists Pte Ltd

36 Kian Teck Road, Singapore 628781, Singapore

In recognition of the organization's Quality Management System which complies with

ISO 9001:2015

The scope of activities covered by this certificate is defined below

Provision of Project Management and Consultancy Services for Oil and Gas Construction Facilities

Certificate Number:	Date of Issue: (Original)	Date of Issue:
41578/C/0001/UK/En	06 November 2016	06 November 2019
Issue No:	Expiry Date:	
3	05 November 2022	

Issued by: *On behalf of the Scheme Manager*

UNITED REGISTRAR OF SYSTEMS URS ISO 9001

UKAS MANAGEMENT SYSTEMS 0043

MEMBER OF MULTILATERAL IAF RECOGNITION ARRANGEMENT

Certificate of Registration

This certificate has been awarded to

Offshore Construction Specialists Pte Ltd

36 Kian Teck Road, Singapore 628781, Singapore

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Provision of Project Management and Consultancy Services for Oil and Gas Construction Facilities

Certificate Number:	Date of Issue: (Original)	Date of Issue:
41578/B/0001/SA/En	04 November 2016	04 November 2019
Issue No:	Expiry Date:	
2	03 November 2022	

Issued by: *On behalf of the Director*

Accredited Certification Body
SAC
QS 2011 24

20. NATA CERTIFICATION

NATA

NATA ACCREDITED LABORATORY

National Association of Testing Authorities, Australia

(ABN 59 004 379 748)

has accredited

Offshore Construction Specialists Pte Ltd

Singapore

following demonstration of its technical competence to operate in accordance with

ISO/IEC 17025

This facility is accredited for the tests shown on the *Scope of Accreditation* issued by NATA

Jennifer Evans
Chief Executive Officer

Date of issue: 14 May 2020
Date of accreditation: 15 July 2013
Accreditation number: 19122
Site number: 21585

NATA is Australia's government-endorsed accreditor of laboratories, and a leader in accreditation internationally. NATA is a signatory to the international mutual recognition arrangements of the International Laboratory Accreditation Cooperation (ILAC) and the Asia Pacific Accreditation Cooperation (APAC).

APS-1-9 / Issue 5 / May 2019

21. BCA CERTIFICATION

Serial No : C2108038

Building and Construction Authority

CERTIFICATE OF LICENCE

This is to certify that

OFFSHORE CONSTRUCTION SPECIALISTS PTE LTD

(Unique Entity Number / ACRA Registration Number : 200720801G)

is licensed as a

General Builder Class 1
(24 Aug 2021 to 24 Aug 2024)

under Part VA of the Building Control Act and Building Control (Licensing of Builders) Regulations 2008

Commissioner of Building Control
Singapore

Date: 25 Aug 2021

22. APPENDICES: CHECKLISTS FOR PRE-COMMISSIONING PROJECTS

Appendix A: Post Award / Execution Planning Checklist

Appendix B: Project Documentation & Engineering Checklist

Appendix C: Procurement Checklist

Appendix D: Typical In-House Equipment Preparation Checklist

Appendix E: Fabrication Checklist

Appendix F: Pipeline Pre-Commissioning Trial Fit Checklist

Appendix G: Pipeline Pre-Commissioning Function Test Checklist

Appendix H: Hired Equipment Checklist

Appendix I: Typical Flood / Clean / Gauge Checklist

Appendix J: Typical Hydrotesting Checklist

Appendix K: Typical Dewatering Checklist

Appendix L: Typical Vacuum Drying Checklist

Appendix M: Typical N2 Purging / Packing Checklist