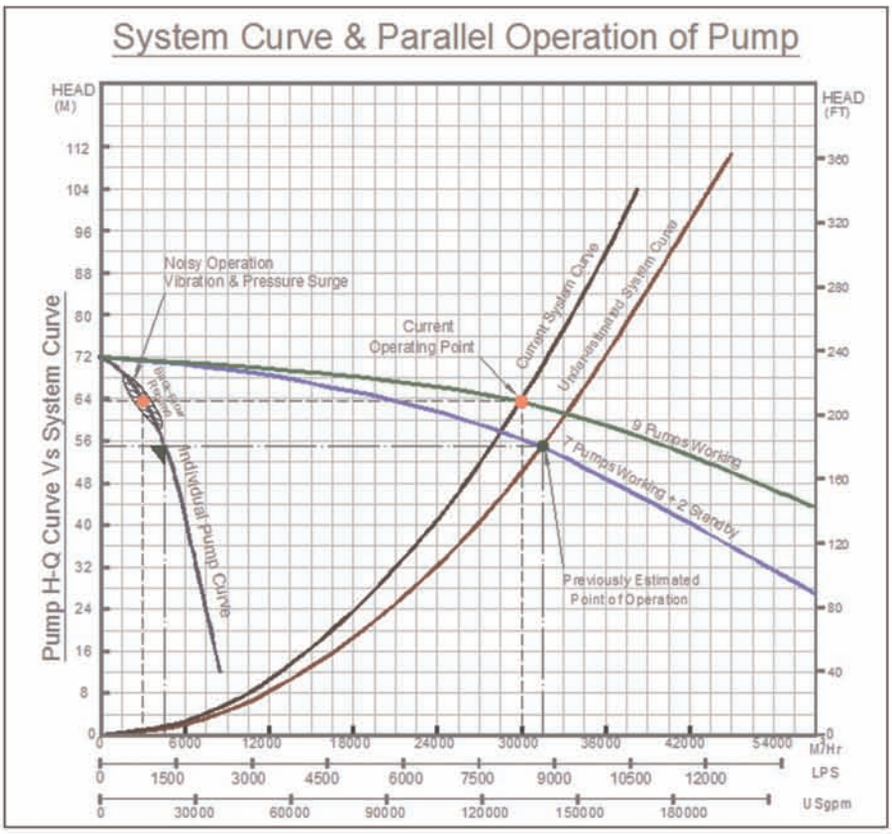
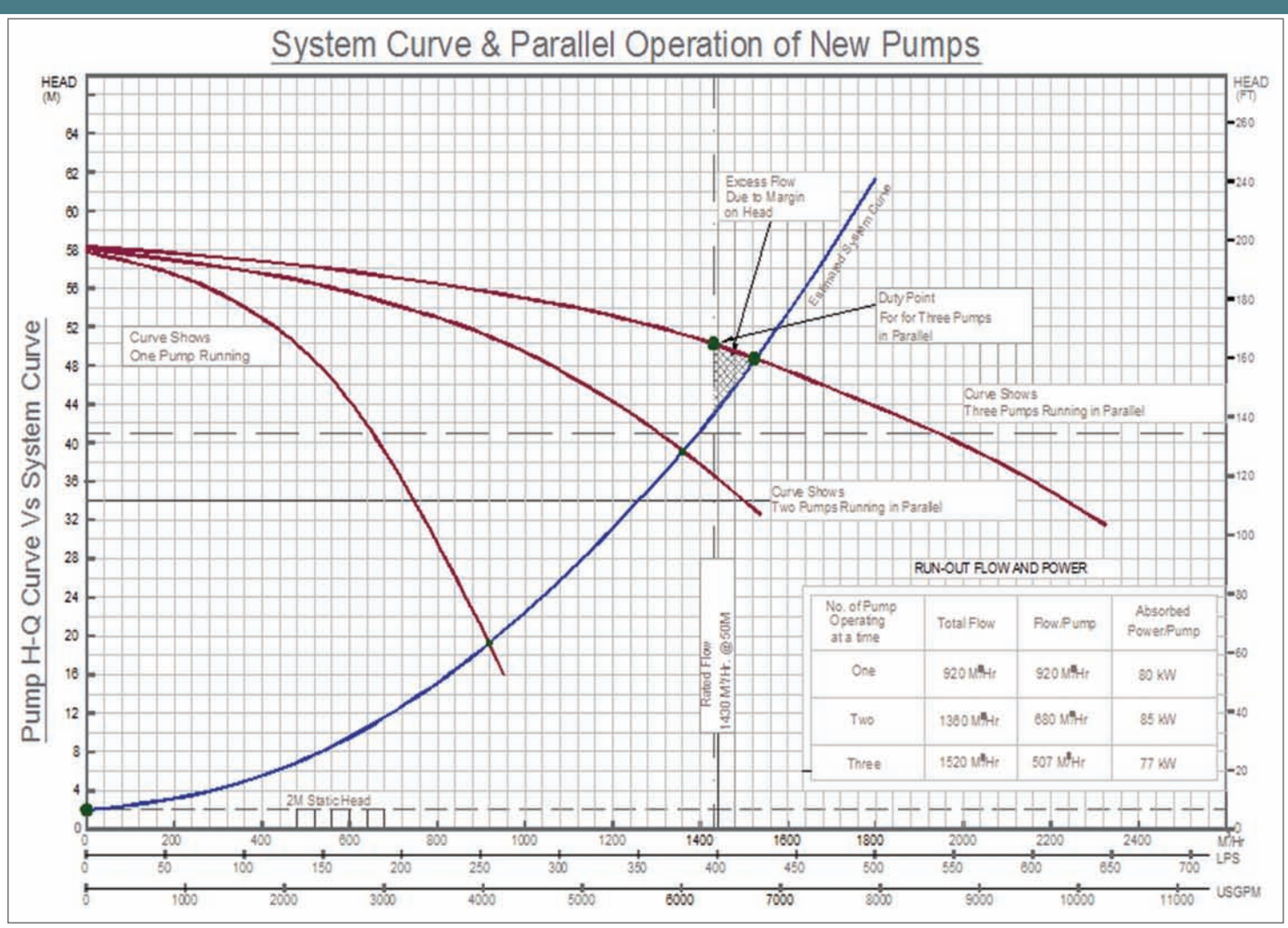


PUMPSENSE
Fluid Engineering Pvt. Ltd.

Centrifugal Pumps-The Best Practices

4 –Day Training & Workshop

Venue: International Class Hotel - Kolkata



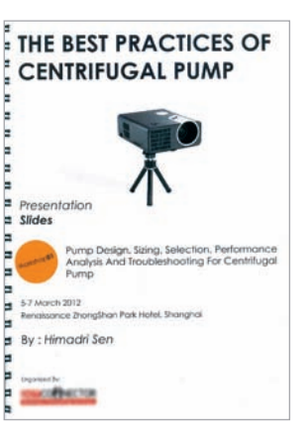
CENTRIFUGAL PUMPS - THE BEST PRACTICES

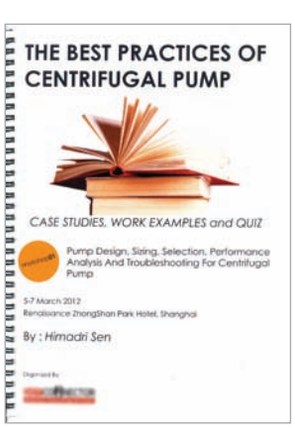
Benefits of the Programme

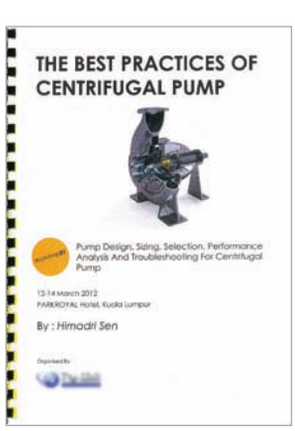
After attending the programme, you will be able to:

Pump Selection	Operation & Maintenance	Energy Optimization
Decide on the most suitable type of centrifugal pump for your application.	Understand and evaluate hydraulic performance of your existing centrifugal pumps. Determine whether the pumps are performing optimally.	Identify opportunities for energy optimization in your existing pumping systems.
Finalize duty parameters, number of pumps, operating speed.	Decide how to operate the pump within the intended service condition envelop.	Use most energy-efficient way of controlling flow through your existing pumps and decide when to use a variable-speed driver.
Estimate the size of pump, efficiency, npshr, motor kW rating.	Understand the failure modes - power, temperature, corrosion, leakage, pressure, vibration, etc.	Decide whether to replace an inefficient pump or retrofit the pump with a custom-designed impeller.
Establish system and pump curves and estimate maximum flow and power required.	Decide on monitoring frequency and control limits.	Identify energy optimization projects with low risk but high energy saving potential.
Familiarize yourselves with various means of monitoring pump performance and health parameters.	Carry out mechanical, hydraulic and installation review of your existing pumping plants.	Understand critical pump parameters you need to review when evaluating the offers for pumps for new projects. Do cost-benefit analysis of any energy optimization project involving pumping systems.
Understand critical pump parameters you need to review when evaluating the offers received from pump makers.	Avoid common operator errors and improve MTBF.	Compute life cycle cost of your pumping system.
Know who are the possible pump suppliers for your requirement.	Change materials of construction of pump components based on field experience.	Decide on specific energy efficient and environment friendly construction features for your pump application.
Decide on pump specification and minimum QA and inspection requirements.		
Decide on specific construction features and materials of construction for your application.	Estimate cost of spares and the best ways of procuring them.	
Understand and quantify cost and delivery implications of your chosen specification.		

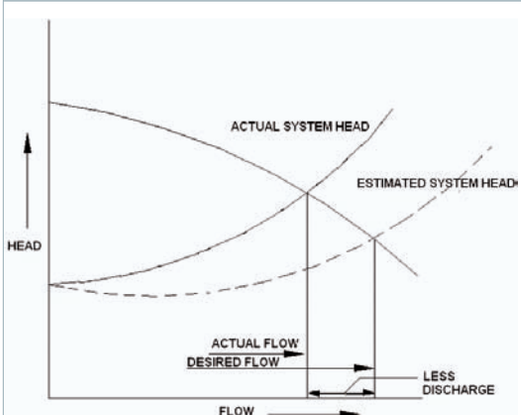
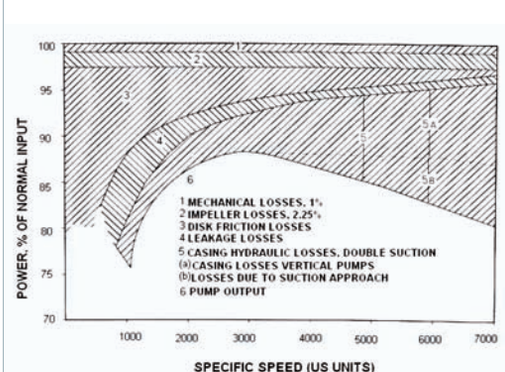
Training and Workshop Handouts

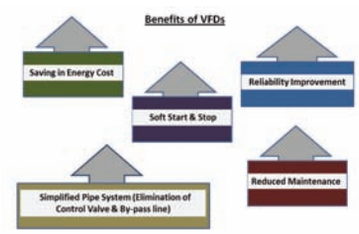
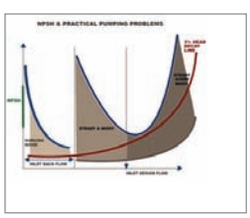
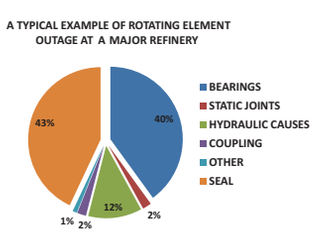


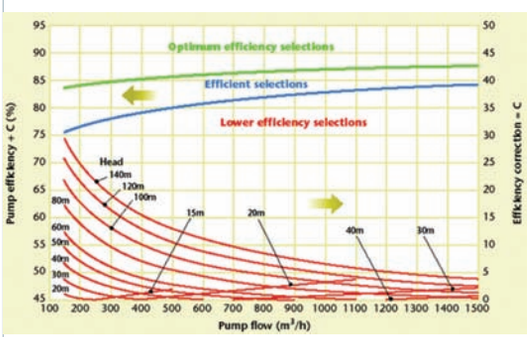
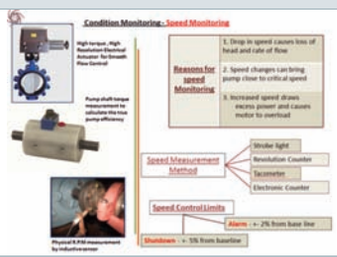
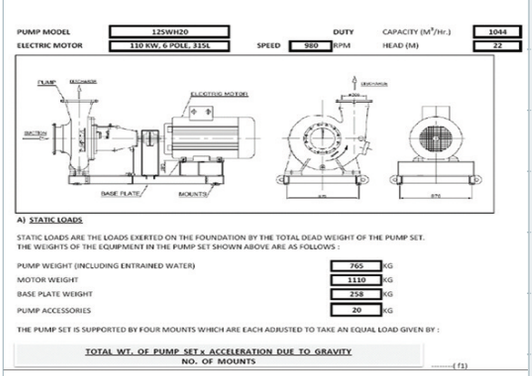




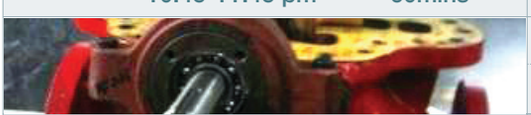
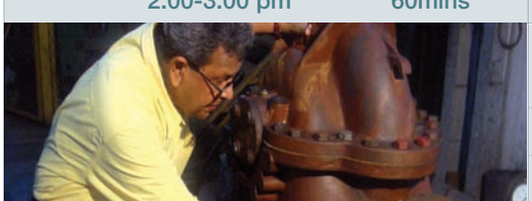
Programme Schedule

Day 1	Time	Duration	Topics to be covered
	9.00-9.15 am	15mins	Introduction to Programme, Structure and Schedule
	9:15 - 10:45 am	90mins	Centrifugal Pumps - Types, Construction, Specifications & Applicable Standards.
			1. Types & selection criteria for centrifugal pumps 2. Product variants 3. Major components 4. Functions of components 5. Classification of impellers & collectors 6. Pump shaft design criteria 7. Stuffing box sealing units-gland packing & mechanical seals 8. Anti-friction & sleeve bearings 9. Driver slection criteria 10. Pump standards
	10.45-11.00 am	15mins	Morning Tea Break
	11.00-12.30 pm	90mins	Hydraulic Principles & performance characteristics of centrifugal pumps
			1. General liquid characteristics and properties 2. Physical principles of centrifugal pumps 3. Concepts related to pressure, head and flow 4. Bernoulli's equation and Euler's equation 5. Hydraulic power and pump efficiency 6. Affinity laws & their applications 7. Dimensional analysis & factoring laws 8. Specific speed, suction specific speed & suction energy 9. NPSHa & NPSHr 10. Efficiency & specific speed
	12.30-1.00pm	30mins	Workshop-1 Centrifugal Pumps - Types, Construction, Specifications & Applicable Standards.
	1:00 2:00pm	60mins	Lunch & Networking
	2.00-3.30pm	90mins	Centrifugal Pumps - Hydraulic & Mechanical Performance.
			1. Losses in pumps & their classification 2. Part flow and overflow operation 3. Axial thrust & radial thrust 4. Flow separation & recirculation 5. Minimum flow - Thermal and stable 6. Temperature Rise 7. Cavitation 8. Noise in centrifugal pumps 9. Vibration in pumps & remedial measures 10. Pressure surge & pressure pulsation
	3:30 - 3:45pm	15mins	Afternoon Tea Break
	3.45-4.45pm	60mins	Workshop - 2. Pump - Hydraulic & Mechanical Performance
	4.45-6.00pm	75mins	Worked Examples in Centrifugal pumps - selection and application

Day 2	Time	Duration	Topics to be covered
	9.00-10.00am	60mins	**Understanding Types of Pumping systems**
			1. Pumping systems 2. Various system curves 3. Selection of pumps for optimization of pump-system interaction 4. Control methods for varying pump output-energy implications 5. Sump design guidelines 6. Suction piping arrangements
	10.00-11.00am	60mins	**Materials of construction**
			1. Factors affecting material selection 2. Material properties 3. Corrosion, erosion & wear 4. Common & special materials of construction 5. Material selection guidelines-Hydraulic Institute Standards & other sources 6. Materials for major pump parts
	11.00 -11.15pm	15mins	**Morning Tea Break**
	11.15-12.15am	60mins	**Quality assurance & testing of centrifugal pumps**
 			1. Inspection & test standards 2. Material inspection 3. Destructive & non-destructive tests 4. Pressure test 5. Performance test 6. NPSHr testing procedures 7. Acceptance criteria 8. Quality plans 9. Inspection agencies
	12.15-1.00pm	45mins	**Application of centrifugal pumps in various industries**
			1. Refinery & Petrochemical 2. Metallurgical industries 3. Power Generation 4. Marine 5. Airconditioning 6. Fire protection 7. Municipal services
	1.00-2.00pm	60mins	**Lunch & Networking**
	2.00-3.00pm	60mins	**Workshop -3**
			Pumping systems, QA & testing of centrifugal pumps.
	3.00-3.15pm	15mins	**Afternoon Tea Break**
	3.15-4.30pm	75mins	**Pump Industry - New technologies, vision/mission for next 25 years**
	4.30-6.00pm	90mins	**Bid Evaluation. Pump Specifications & Data Sheets.**
			1. Pump specification & selection 2. Steps in selecting & purchasing pump 3. Pump datasheet/specification 4. Bid evaluation 5. Bid evaluation-point rating system 6. Conclusion

Day 3	Time	Duration	Topics to be covered
	9:00 - 10:15 am	75mins	**Energy optimization in pumping systems. LCC & Retrofit opportunities**
			1. Energy efficiency in pumping systems - an overview 2. Selection of pumps-optimization of pump - system interaction 3. Pump efficiency norms - a survey of guidelines 4. Review of control methods for varying pump output - energy implications 5. LCC analysis & energy optimization in pumping systems 6. Pump retrofit and upgrades for energy optimization
	10.15-11.00am	45mins	**Condition Monitoring in Centrifugal Pumps**
			1. Purpose of condition monitoring 2. Condition monitoring frequency 3. Condition monitoring - various parameters 4. Condition monitoring - control limits
	11.00-11.15am	15mins	**Morning Tea Break**
	11.15 am -12.00pm	45mins	**Workshop 4 – pump selection.**
	12.00-1.00pm	60mins	**Diagnostics & Troubleshooting of Centrifugal Pumps**
	1.00-2.00pm	60mins	**Lunch and Networking**
	2.00-2.45pm	45mins	**Erection & Commissioning Issues in Pumping Installations**
			1. Pre-installation instruction 2. Site selection & site preparation 3. Design & dimension of the pump foundation 4. Concrete mix pour & epoxy pour 5. Base plate & sole plate preparation 6. Grouting 7. Installation & commisioning
	2.45-3.00pm	15mins	**Workshop 5 – Pump Application Calculations.**
	3.00-3.15pm	15mins	**Afternoon Tea Break**
	3.15-4.00pm	45mins	**Assembly Sequence of split case pumps. Film – World of Pumps.**
	4.00-4.45pm	45mins	**Programme Recap – Pump Construction & Pump Performance**
	4.45-5.30pm	45mins	**Programme Recap – Pumping Systems, Materials of Construction, Pump Testing & QA**
	5.30-6.00pm	30mins	**Conclusion & feed-back**

	LOCATION:	Pumpsense Assembly and Test Unit in Howrah
Day 4	TOPICS:	Centrifugal Pump Components, Hydrotest, Performance Test, Assembly & Dismantling Of Centrifugal Pumps.

Day 4	Time	Duration	Topics to be covered
	9.00-9.30 am	30mins	**Pump Components**
			1. Shaft, Impeller, Wear Rings, Shaft Sleeves, glands, lantern rings, mechanical seals etc. Review of design and material selection criteria 2. Review of functions of components 3. QA reports 4. Critical Dimensions- tolerances
	9.30-10.30 am	60mins	**Pump Assembly / Dismantling**
			1. Assembly sequences of a mechanical seal fitted split case pump 2. Dismantling of a mechanical seal fitted split case pump
	10.45-11.45 pm	60mins	**Pump Assembly/Dismantling continued**
			1. Assembly sequences of a packed gland two stage split case fire pump 2. Dismantling of a mechanical seal fitted end suction pump
	11.45-1.00 pm	75mins	**Performance Test**
			1. Performance test of a split case pump at multiple speeds using VFD 2. Performance test procedure; Compliance requirements of ISO 9906 class1 3. Preparation of pump test sheets and test curves
	1.00-2.00 pm	60mins	**Lunch and Networking**
	2.00-3.00 pm	60mins	**Hydrostatic Pressure Test**
			1. Hydrostatic pressure test of a pump casing at 150% of the maximum pressure 2. Acceptance criteria for pressure test 3. Seal integrity test of a mechanical seal fitted pump
	3.15-4.15 pm	60mins	**NPSH Test**
			1. NPSH test procedure- control of NPSHa in the test set up 2. NPSH test of a split case pump by suction valve throttling 3. Special precautions needed during NPSH test 4. Recording and tabulating NPSH test data 5. Preparing 3% head drop NPSH curve
	4.15-5.00 pm	45mins	**Pre-shipment Inspection**
			1. Final checks- completeness, cleanliness 2. Pre-shipment inspection report 3. Packing/Fumigation 4. Storage of pump at site
	5.00-6.00 pm	60mins	1. **Questions & Answers**
			2. **Feedback & Conclusions**
			3. **Distribution of Certificates**

Two/Four Day Training Programme in Centrifugal Pumps

List of Programmes Conducted by Pumpsense in the Recent Past

Sl no	Name of the Programme	Programme emphasis	Organization	Participant Profile	Location	Period
1.	PUMPLIFE	Selection, Operation & Maintenance	Tata Steel	Engineers from plant, Mines & City Services	Jamshedpur	February 2010
2.	PUMPSCHOOL	Selection, Applications & Marketing	Mather + Platt	Design, sales & service, Applications Engineers	Pune	October 2010
3.	PUMPSCHOOL	Selection, Applications & Marketing	Mather + Platt	Design, sales & service, Applications Engineers	Pune	December 2010
4.	PUMPSCHOOL	Selection, Applications & Marketing	Mather + Platt	Design, sales & service, Applications Engineers	Pune	February 2010
5.	PUMPS – BEST PRACTICES -I	Design & Application	Public Seminar I	Engineers from EPC, process, power & municipal segments	Kuala Lumpur	April 2011
6.	PUMP - MASTERCLASS	Design, Selection & Applications	MMHE/ PETRONAS	Design & Applications, Engineers	Johor Bahru	April 2011
7.	PUMPSCHOOL	Selection, Applications & Marketing	Ruhrpumpen	Design, Sales & Applications Engineers	Cairo	May 2011
8.	PUMPGREEN	Energy optimization	Ruhrpumpen	Works engineers	Suez	May 2011
9.	PUMPS – BEST PRACTICES - I	Design & Application	Public Seminar I	Engineers from EPC, process, power & municipal segments	Dubai	July 2011
10.	PUMPS – BEST PRACTICES - II	Operation & Maintenance	Public Seminar II	Engineers from EPC, process, power & municipal segments	Dubai	July 2011
11.	PUMPS – BEST PRACTICES - I	Design & Application	Public Seminar -I	Engineers from EPC, process, power & municipal segments	Singapore	July 2011
12.	PUMPS – BEST PRACTICES - II	Operation & Maintenance	Public Seminar II	Engineers from EPC, process, power & municipal segments	Singapore	July 2011
13.	PUMPS – BEST PRACTICES - I	Design & Application	Public Seminar -I	Engineers from EPC, process, power & municipal segments	Kuala Lumpur	July 2011
14.	PUMPS – BEST PRACTICES - II	Operation & Maintenance	Public Seminar -II	Engineers from EPC, process, power & municipal segments	Kuala Lumpur	July 2011
15.	PUMPSCHOOL	Selection & Application of Industrial Pumps	NOPWASD (Egypt)	Engineers from Water Supply & Sewage Board of Egypt	Kolkata	March 2012
16.	Centrifugal Pump – Best Practices	5 day programme on Centrifugal Pumps and Mechanical Seals	Dot Connectors	Engineers from BP, Shell, Power Companies & Water Utilities	Shanghai	March 2012
17.	Centrifugal Pump – Best Practices	5 day programme on Centrifugal Pumps and Mechanical Seals	Toplink Shell, Power Companies & Water Utilities	Engineers from BP,	Kuala Lumpur	March 2012
18.	PUMPSCHOOL	Design & Application of Centrifugal Pumps	Delivered jointly with Australian Industrial Marketing	Company Training of design & Applications Engineers	Melbourne	May 2012
19	PUMPSCHOOL	Design & Application of Centrifugal Pumps	Masterflow Pumps	In – Company Training of Apllications Engineers	Sydney	May 2012
20.	Comprehensive Pump Services	4 day programme on Centrifugal Pumps and Mechanical Seals	i Knowledge	Engineers from Process Industries	Kuala Lumpur	June 2012
21.	Centrifugal Pump – Master Class	4 day programme on Centrifugal Pumps	Olygen	Engineers from Mining, Water Supply & Process Industries	Johannesburg	July 2012

OUR PRODUCTS

A comprehensive range of horizontal and vertical dry pit sewage pumps are available to cover a wide range of duties at four pole, six pole and eight pole speeds.

Our single stage range of NFPA20 fire pumps cover duties up to 5000usgpm and beyond. Pumps can be supplied with certification by independent inspection agencies.

Standard split case range covers both single and two stage pumps for capacities up to 3000 m^3/hr and heads up to 200m. Many customized options are available

Complete range of ISO 2858 End Suction pumps are optimized for highest possible efficiency. All pumps are available in high working pressure versions with strengthened bearing arrangement.

Large end suction pumps cover sizes up to 400mm. These pumps are available for air conditioning, industrial cooling water supply, and marine external fire services.

Two stage split case pumps are available for high pressure cleaning and high head industrial applications. Pumps are offered with both internal and external cross-overs for capacities up to 1200m^3/hr and heads up to 400m.

Single stage double volute split case pumps are offered both in horizontal and vertical shaft configuration. Customised designs are offered for special applications.

Two stage NFPA20 Split Case fire pumps incorporate two double entry impellers for high suction lift capability and complete axial thrust balance. The pumps are available for rated flows up to 1500 gpm and heads up to 300 m at 2950rpm.

Test Bed at Pumpsense is fully compliant with the requirements of ISO 9906. Test set up is completely automated for flow control and data acquisition.

PUMPSENSE FLUID ENGINEERING PVT. LTD

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