EUROPEAN COMMISSION
DIRECTORATE-GENERAL ENERGY AND TRANSPORT

New Energies & Demand Management
Promotion of Renewable Energy Sources & Demand Management

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THE EUROPEAN
MOTOR CHALLENGE PROGRAMME

Pumping Systems Module

Contents

1. Introduction to the Pumping Systems Module document

This document is subsidiary to the Motor Challenge Programme (MCP) "Partner Guidelines". It defines what an MCP Partner action plan should cover, (if the Partner company's commitment includes Pumping Systems)[1]. In particular, it explains what a Partner does for each of the following steps of participation in the Motor Challenge:

- **Inventory** of Pumping Systems
- **Assessment** of the applicability of possible energy savings measures
- **Action plan**, presented to the Commission, which defines what the Partner has decided to do to reduce operating costs by improving energy efficiency
- **Annual report** of progress on the Action Plan.

Note that documents relating to the Inventory and the Assessment are in house, confidential documents, while the Action Plan and Annual Report are reported to the Commission.

2. Inventory of Pumping Systems

As a first step towards identifying applicable energy savings measures, an MCP Partner should establish an **Inventory** of Pumping Systems and key operating characteristics. The Inventory is established in 3 phases.

A. Basic system description

This consists of consulting company records or carrying out simple measurements, in order to assemble the following data.

1. List of 50 largest pumps (by total pump power rating): size and type
2. Function of these systems
3. Power consumption of each of these pumps
4. Demand profile: estimated variation during day/week
5. Type of control system
6. Operating hours/year, and hence annual energy consumption
7. Problems or maintenance issues specific to the pump

In many organisations, most or all of this data could be assembled by in house staff.

B. Documentation and measurement of system operating parameters

Documenting or measuring the following elements is desirable for all pumping systems, and essential for large systems (over 100 kW). Collection of this data will require a fair level of technical expertise, either from in house engineering staff or from a third party, such as an MDSC endorser.

[1] Refer to the "Partner Guidelines" for an explanation of terms such as "Partner", "action plan" and "commitment".

Because of the large variety of pumping systems, it is not sensible to give a definitive list of points to look for in the assessment, but the following is a useful list of key things to look out for.

Poor pump selection or poor maintenance

1.) Excessive pump maintenance, which can indicate:
- Pumps in cavitation
- Badly worn pumps
- Pumps that are misapplied for the present operation

2.) Fixed throttle variation. Pumps throttled at a constant head and flow indicate excess capacity. The pressure drop across a control valve represents wasted energy, which is proportional to the pressure drop and flow.

3.) A noisy pump generally indicates cavitation from heavy throttling or excess flow. Noisy control valves or bypass valves usually mean a high pressure drop with a corresponding high energy loss.

4.) Changes from design conditions. Changes in plant operating conditions (expansions, shutdowns, etc) can cause pumps that were previously well applied to operate at reduced efficiency.

5.) Pumps with known over-capacity. Overcapacity wastes energy because more flow is pumped at a higher pressure than required.

Poor control

6.) Any pump with large flow or pressure variations When normal flows or pressures are less than 75% of their maximum, energy is probably being wasted from excessive throttling, large bypassed flows, or operation of unneeded pumps.

7.) Bypassed flow, either from a control systems or deadhead protection orifices, is wasted energy.

8.) A multiple pump system. Energy is commonly lost from bypassing excess capacity, running unneeded pumps, maintaining excess pressure, or having a large flow increment between pumps.

3. Assessment of energy saving technical measures

Of course, the applicability of particular measures, and the extent to which they might save money, depend upon the size and specific nature of your operation. Only an assessment of your systems and of your company's needs can determine which measures are both applicable and profitable. This could be done by a qualified pumping system service provider (who might be an MCP Endorser) or by qualified in house engineering staff.

The assessment conclusions will identify the measures that are applicable to your system, and will include an estimate of the savings, the cost of the measure, as well as the payback time. Assessment results are confidential in house data, not reported to the Commission.

The following box shows the potentially significant energy savings measures that might be applicable to your system.

Control

1.) Shut down unnecessary pumps
This obvious but frequently overlooked energy saving measure can often be carried out after a significant reduction in the plant's use of water or other fluid. If excess capacity is used because flow requirements vary, the number of pumps in service can be automatically controlled by installing pressure switches on one or more pumps.

2.) Use Multiple pumps.
Multiple pumps offer an alternative to variable speed, bypass, or throttle control. The savings result because one or more pumps can be shut down at low system flow while the other pumps operate at high efficiency. Multiple small pumps should be considered when the pumping load is less than half the maximum single capacity.

3.) Control by throttling
Controlling a centrifugal pump by throttling the pump discharge wastes energy. Throttle control is, however, generally less energy wasteful than two other widely used alternatives: no control and bypass control. Throttles can, therefore, represent a means to save pump energy.

4.) Use Variable speed drives
Variable speed drives yield the maximum savings in matching pump output to varying system requirements, but they do have a higher investment cost compared to the other methods of capacity control.

Pump selection

5.) Replace oversized pumps
Oversized pumps represent the largest single source of wasted pump energy. Their replacement must be evaluated in relation to other possible methods to reduce capacity, such as trimming or changing impellers and using variable speed control.

6.) Use a small booster pump
The energy requirements of the overall system can be reduced by the use of a booster pump to provide the high-pressure flow to a selected user and allow the remainder of the system to operate a lower pressure and reduced power.

7.) Trim or change impellers
Trimming centrifugal pump impellers is the lowest cost method to correct oversized pumps. Head can be reduced 10 to 50 percent by trimming or changing the pump impeller diameter within the vendor's recommended size limits for the pump casing.

Maintenance

8.) Restore internal clearances
This measure should be taken if performance changes significantly. Pump capacity and efficiency are reduced as internal leakage increases due to excessive clearances between worn pump components: backplate; impeller; throat bushings; rings; sleeve bearings.

9.) Apply coatings to the pump
Applying coatings to the pump, particularly the volute, will reduce friction losses.

Details of Energy Saving Measures

This document only gives an overview of energy saving measures in pumping systems. For further information, please refer to the MCP Tool Box, which contains guides on technical measures and on Life Cycle Evaluation of pump operating costs. It should be kept in mind that savings on factors such as maintenance, unplanned outage, installation and commissioning are often greater than from reduced energy costs. (In the table below space is left to include these factors where they can be easily estimated.)

Assessment results

Pump reference/description	Specific proposed action	Estimated annual energy savings (1)	Change in annual O&M costs (2)	Additional investment cost (2)	Estimated payback time (months)

Legend

(1) When energy savings cannot be precisely measured (as is often the case), they can be estimated from the assessment results and generally accepted technical coefficients.

(2) Investment and O&M costs are estimates of changes in costs, with respect to what would have been spent without Partner commitment to the Motor Challenge. This may be, for instance: additional investment for higher performance equipment; increase/decrease in maintenance costs; associated savings from better quality or reliability, etc.

4. Action plan

Your company's action plan, you should indicate:

- the measures you have decided to implement, and the time scale for implementation;
- the reasons for excluding the other measures.

The Action Plan is presented to the Commission. After approval, your organisation will be recognised as an MCP Partner.

Energy Savings Measures	Feasibility (1)	Specific Actions (2)	% Covered (3)	Time table (4)	Expected savings (5) (MWh/year)

Legend:

(1) **Feasibility.** Indicate obstacles to application by one or more of the following codes:
NA Not applicable for technical reasons
NP Not profitable
NC Not considered, because evaluation would be too expensive
If this field is left blank, the measure is considered to be both applicable and profitable.

(2) **Specific Actions.** Several specific actions may be adopted to implement one energy saving measure.

(3)

(3) **% Covered.** This column should be used to indicate in what proportion of the systems the specific actions will be implemented. This can be evaluated according to the most convenient indicator: number of systems; power; energy consumption. Specify the indicator used, as by: "%"; "%kW", %kWh"

(4) **Time table.** The time scale at which the action will be implemented. This might be a specific period or date, or might depend on some other action, for instance "When pumpset is replaced", or "When paint shop is refurbished".

(5) **Expected savings** in MWh/year. This will often be an estimate, based on generally accepted practice.

5. Annual Report

The Annual Report to the Commission specifies progress made in carrying out the Action Plan, and will comment on any new or amended initiatives. The following reporting should be used with progressive updating on an annual basis. The two left hand columns are copied from the Partner's Action Plan as approved by the Commission.

Approved Action Plan		Annual report for year 20xx
Actions decided upon to implement energy savings measures, by pumping system	Agreed upon time scale for action	Progress on action, as percentage achieved, and comments where appropriate
Action 1		
Action 2		

Partners may find it useful to produce parts of the following synthesis of the results of commitment to the Motor Challenge. They are invited (but not required) to submit the Synthesis to the Commission.

Annual report synthesis		
	This year	Since commitment
Percentage of actions in Action Plan completed		
Estimated total investment (000 EUR) (1)		
Estimated change in O&M costs (000 EUR) (1)		
Estimated energy savings (MWh) (1)		

(1) See above, legend for table "Assessment results"