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Hungary Deliverable: Veszprém Hospital – Monitoring and Verification Plan

Prepared by

Electrotek Concepts, Inc.
Arlington, Virginia USA

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Measurement and Verification Plan

1 Background

Csolnoky Ferenc Korhaz és Rendelointezet, Veszprem, (hereinafter the Hospital) participates in an energy efficiency demonstration project, in partnership with Electrotek Concepts, Inc and its subcontractor, EGI Contracting-Engineering Co Ltd (hereinafter EGI) This work is being funded by the United States Agency for International Development (USAID) under contract DHR-C-00-95-00064-00 The objective of this project is to demonstrate practical energy and cost saving interventions and the methodology of implementing them

In accordance with the workplan of the project and the agreement between the Hospital and Electrotek, the results of the interventions implemented need to be evaluated and a portion of the savings achieved shall be used by the hospital to improve its quality of service The purpose of the current measurement and verification plan is to establish the methodology of identifying the savings and their expected value for the individual projects/interventions

2 The methodology of identifying savings for the individual projects

2 1 Replacement of steam traps in the laundry

2 1 1 Baseline situation

The steam heated process equipment of the laundry are served by 23 steam traps as listed in the following table

Equipment	Steam load	Pressure	Number of steam traps
Large ironer	300	8 5	3
Small ironer	150	8 5	3
Large dryer	300	10	2
Small dryer	80	6	2
Press iron	80	8	8
Finisher	180	10	1
DHW generator	250	6	4

The steam traps were inspected by an ULTRAPROBE 500 type steam trap tester before the intervention This device converts the ultrasonic sound generated by the steam flow, whose intensity is proportionate to the velocity, to an audible frequency The actual flow can be identified as a function of the intensity and sensitivity readings of the instrument with the help of the following calibration chart

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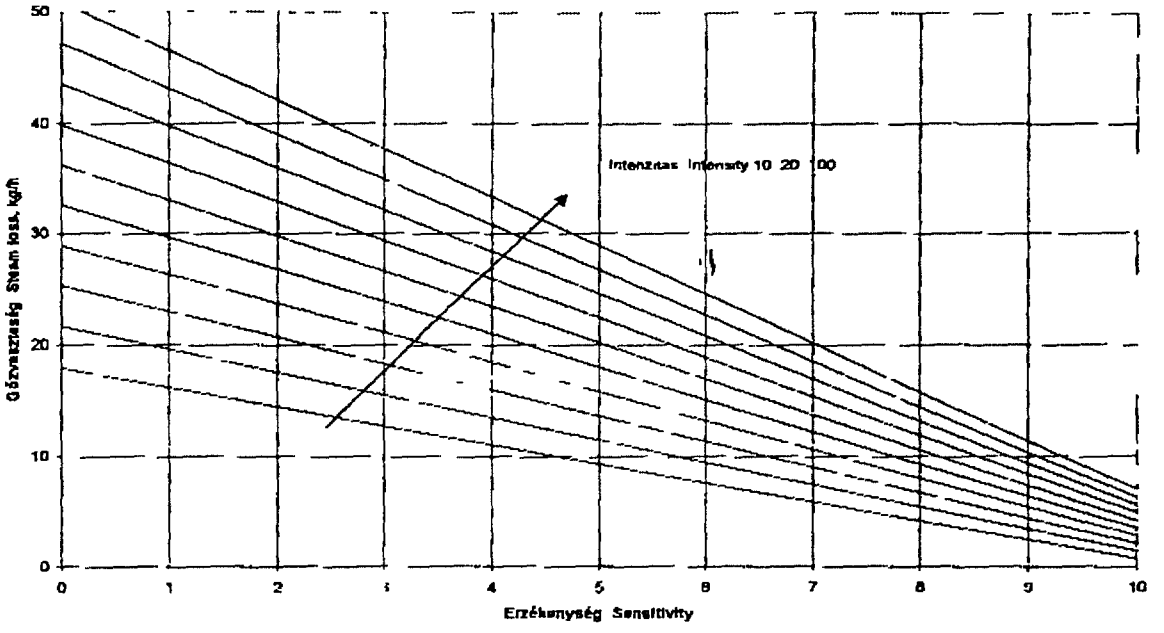

The measured values and identified steam losses found during the inspection are summarized in the following table

Equipment served	Sensitivity	Intensity	Steam loss, kg/h
Large ironer	5	24	12
Large ironer	5	56	19
Large ironer	9	50	7
Small ironer	5	24	12
Small ironer	5	42	16
Small ironer	5	33	14
Large drier	5	96	28
Large drier	5	37	15
Small drier	9	40	6
Small drier	9	20	4
Press iron	9	10	3
Press iron	5	10	9
Press iron	9	30	5
Press iron	9	30	5
Press iron	9	10	3
Press iron	9	10	3
Press iron	9	50	7
Press iron	10	15	1
DHW steam generator	5	83	25
DHW steam generator	5	28	13
DHW steam generator	5	87	26
DHW steam generator	5	24	12
Total			245

Thus the total steam loss is identified 250 kg/h The steam loss has two major reasons The majority of the losses are caused by poor technical condition of the

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steam traps but it is also important that the thermostatic type traps are not perfectly suitable for the equipment they serve

2 1.2 Situation after the intervention

In the course of the project reliable inverted-bucket type steam traps will be installed The working principle of this type of steam trap is better suited to the equipment of the laundry and the probability of steam trap failure is much lower than earlier Therefore it is expected that the total 250 kg/h steam loss will be avoided Unlike that of the old steam traps, the servicing of the new ones is ensured so no losses are expected to occur during their operation in the long term It is expected that the savings will be maintained In order to test the proper operation of the new traps a new inspection with the ULTRAPROBE 500 will be carried out after the installation of the new traps In case proper operation is detected the 250 kg/h savings can be safely assumed

Although due to the many other influencing factors it is no suitable for direct quantification of the savings the readings of the gas consumption in the laundry boiler house can well demonstrate the effect of the intervention

In determining the savings it is assumed that the steam consumption of the laundry is rather constant and the load of the laundry will not considerably change as compared to the 'before the intervention' state

2 1 3 Calculation of savings

Avoided loss	250	kg/h
Operation time of the laundry	7,5	h/day
No of working days a year	250	
Annual savings		
(250 day * 7,5 h/day * 250 kg/h)	470	t steam
Steam cost	2300	HUF/t
Annual savings		
(2300 HUF/t* 470 t)	1080	thHUF

2 2 Automatic heating control for building A

2 2 1 Baseline situation

The energy used for space heating is not metered separately in building A The designed heat demand of the building for – 15°C ambient temperature is 780 kW Calculating with 3050 degree-day value valid for Veszprem the average space heating heat demand is 430 kW The length of the heating season in an average year is 4500 h/year thus the total heat use in design state is

430 x 4500 = 1935 MWh = 6950 GJ

There is no automatic heating control in the building The manual control changes the flow of circulated heating water with a valve This method is not proper for the building because the secondary heating system was designed for temperature control rather than flow control

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The difference between the actual heat use and the designed heat demand was checked by a walk through audit spot checks of indoor temperature and a two-month temperature logging in 4 rooms prior to the intervention It was found that the actual heat consumption exceeds the design value by 18 %

The main findings and conclusions of the investigation were the following

- Overheating was found in all rooms its level varying between 2 and 5 °C The average value of overheating is 3 °C, which is equivalent to 18% excess energy use under Veszprem weather conditions
- During the walk-throught audit 23% of the windows were found open at 0 °C ambient temperature This also indicates that the rooms were overheated
- According to general engineering experience by installing automatic heating controls some 10% energy savings can be achieved in case of a manually well controlled building and some 25% in case of an uncontrolled building Based on the pre-project control method of the building and the existence of separate heating circuits for the northern and southern building sections it can be safely estimated that the 18% savings calculated from the overheating is acceptable

Based on the above considerations the current heat use of the building is established as 8500 GJ/year

2 2.2 Situation after the intervention

With the installation of the new automatic heating controls the system itself will also change it will be a constant flow variable supply temperature system The effects of the intervention will be checked as follows

- Long-term temperature logging in the same 4 rooms where this investigation were carried out before the project
- In the course of a walk-through audit spot checks of indoor temperatures will be made in selected rooms and the number of open windows will be counted

Using the results of the above survey the difference between the actual heat use and the design status will be identified similarly to the base-line situation and annual heat use will be calculated

2 2 3 Calculation of savings

The savings will be identified as the difference between the base-line energy use and after-project energy use normalised to an average year

It is estimated that as the result of the project the energy use will be reduced to the design value i e the annual space heating energy use will be 6950 GJ/year

Annual savings (8500 GJ– 6950 GJ)	1550 GJ
Unit price of heat	1100 HUF/GJ
Annual cost savings (1100 * 1550)	1705 thHUF/year

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2.3 Water saving sanitary equipment

2 3.1 Baseline situation

The water use of the outpatient is metered by a water gauge The practically constant monthly water use increase to 2000 m3/month in 1995 It is evident that the reason of the high water use is mainly that the faucets and flushers in the building are regularly left open To a miner extent mechanical failures of these devices are also responsible for the high water use As a temporary solution in February 1996 the boiler house operators were instructed to inspect the building regularly (3 times a day) and turn off the taps This resulted in considerable savings already The monthly water consumption data for the beginning of 1996 were as follows

Month	Water use m³
January	2000
February	1695
March	1002
April	683

As the later data are affected by the regular inspections which started in February, the 1995 average and the January data i e 2000 m^3/month will be used as baseline for the calculation of the savings

2 3 2 Situation after the intervention

The basis for identifying the savings will be the regular reading of the water gauge of the building The monthly reading will be compared to the readings for the same month before the intervention This approach assumes that the occupancy of the building does not change as a consequence of the project It is also assumed that no seasonality of the water use occurs therefore any remarkable changes in the monthly water consumption figures will be due to the project

As the water use of similar buildings does not show seasonality the reduction of the data shown in the previous table is assumed to be due to regular inspections made by the boiler operators This fact can help in estimating the savings to be achieved by the project

As in the course of the project the most frequently used faucets and flushers will be replaced by automatic ones it can safely be estimated that at least the half of the above savings will be achieved

2 3 3 Calculation of savings

Annual savings		
(12 * 700 m³)	8400	m³
Unit price of water	150	HUF/m³
Expected cost savings	1260	thHUF

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2.4 New boiler for the outpatient building

2 4.1 Baseline situation

The building is currently supplied with heat by a 105 m long, ND 80 steam pipe line The insulation of the pipe is in a very poor condition because the underground concrete conduit is often flooded by groundwater The steam traps in the substation of the building are also in a poor condition, which was checked by an ULTRAPROBE 500 instrument as described at the laundry project

According to the available technical literature and engineering experience the heat transfer of such a poor, often flooded insulation can be calculated with a coefficient of 4 W/m^{2}K Thus the total heat loss over the pipeline and through the steam traps can be calculated as follows

Pipeline heat loss		
Heat transfer coeff	4	W/m²/K
Heat transfer surface	26	m²
Average steam temp	100	°C
Average ambient temp	10	°C
Heat loss	9,38	kW (4 * 26 * [100-90])
Annual operation hours	4500	h
Annual heat loss	42,2	MWh = 152 GJ
Unit price of heat	1100	HUF/GJ
Annual loss	167	thHUF (152 * 1100)

Steam loss to the steam traps

The loss of steam trap 1	18	kg/h
The loss of steam trap 2	22	kg/h
The loss of steam trap 3	15	kg/h
Total steam loss	55	kg/h
Annual operation hours	4500	h
Annual steam loss (4500 * 55)	248	t
Unit price of steam	2300	HUF/t
Annual loss	570	thHUF

Total annual loss (570 + 167)	740	thHUF

2 4 2 Situation after the intervention

After the project is implemented both the substation and the pipeline will be removed therefore both losses will be entirely avoided Although there is a further saving due to the better efficiency of the new boiler it is very difficult to clearly identify as the efficiency of the existing boiler will be somewhat lower due to the reduced load Therefore in the calculation of the savings only the avoided losses of the pipeline and the substation will be taken into account

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2.4.3 *Calculation of savings*

With respect with the above consideration the savings will be equivalent to 152 GJ heat and 248 t steam, which is equivalent to 740 thHUF

2 5 Indoor lighting upgrading

2 5.1 *Baseline situation*

In the course of the project some of the incandescent bulbs will be replaced by fluorescent tubes The electricity consumption of the lighting is not separately metered but from the aspect of the project it is not necessary, because knowing the number of bulbs replaced and their capacity as well as the number of operation hours a year, the energy consumption before the project can be accurately calculated As in the course of the project practically only 100 W bulbs will be replaced and the number of operation hours is 3500 h/year the energy consumption will be calculated as follows

Energy use = number of bulbs x 0,1 kW x 3500 h/year [kWh/year]

2.5 2 *Situation after the intervention*

The electricity use of lighting will not be metered after the project either, because this can also be accurately calculated from the number of new lights, their capacity including that of the ballast and the number of operation hours a year The lights to be installed will be 2x40 W type fluorescent sets whose capacity including the ballast is 89 W each As the number of operation hours is not affected by the project the after – project energy consumption will be calculated as follows

Energy use = number of new lights x 0 089 kW x 3500 h/year [kWh/year]

It is noted here that one 2 x 40 W new fluorescent light will replace two 100 W bulbs

2 5 3 *Calculation of savings*

In order to simplify the method savings will be calculated with the specific savings determined below

The savings normalised to 1 kW installed new capacity can be calculated as follows

Installed new capacity 1 kW_{new}
(1000/89=11 2 tube sets)

Equivalent installed capacity before the project
(11 2x2x100 W bulb) 2 25 kW

Specific savings 1 25 kW/kW_{new}

The annual savings achieved (operating hours 3500 h/year, average unit price of electricity 10 HUF/kWh)
Savings = installed new cap kW x 1 25 x 3500 h/year x 10 HUF/kWh [HUF/year]

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3 Miscellaneous

Both EGI and the Hospital agrees to the methodology devised in the current plan for the identification of savings achieved by the interventions implemented in the framework of the project and accepts the results given by the methods

The methodology described in this plan can only be modified if a protocol on the change is countersigned by the Hospital and EGI

Signed by EGI

Signed by Hospital

02/26/1998 Budapest

Zoltan Lontay
Head of Department

Istvan Kovacsics
Head of Section

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