

## **Energy Consumption Costs**

For any new asset (the sum of all items covered by one invitation to tender) connected to the CERN electrical network, with an energy consumption exceeding 5 GWh per year or a power consumption exceeding 500 kW, energy consumption cost shall be included in the adjudication price whenever possible and appropriate.

This document establishes the general guidelines and summarises the main points to be addressed during the Start-up Meeting.

### **Points to be addressed during the Start-up Meeting and preparation of Tendering documents**

To calculate energy consumption (or energy losses), a detailed description of the operation conditions (load cycle, expected hours of operation, nominal AC input voltage and frequency, ambient temperature, percentage delivering of the rated power, etc.) has to be provided in the Technical Specification. The description shall enable, both the Contractor and CERN, to calculate and measure the energy consumption with standard industry equipment. The measurement shall demonstrate the energy consumption for the asset(s) over its estimated (or given) lifetime in kWh.

The energy consumption shall be determined by the Bidder and the value of the energy consumption shall be entered into the Tender Form, based on the price per kWh given by CERN (IPT-PI). The cost per kWh to be used in the tendering documents shall be updated every year (or more frequently if required). It shall be based on the average energy cost for CERN for the subsequent years. It shall include transmission, CEE, and Capacity costs.

Together with its bid, the Bidder shall provide evidence (calculations, data sheets, measurements, etc.) of the energy consumption of the quoted asset(s). CERN will carry out its own verification and testing of the energy consumption values given by the Bidder. For Contract adjudication purposes, CERN will include in the total FCA price the total energy consumption cost in CHF. In case energy consumption measured by CERN is higher than indicated by the Contractor, penalties shall be applied. As a reminder, energy consumption is not an acceptance criteria.

Similarly, in case of asset(s) specifically designed for CERN, a bonus system may be implemented to encourage Contractors to further improve the design and achieve higher energy efficiency during the design phase.

Concrete examples for which energy costs shall be considered:

Power Converters
Transformers
UPS systems
AC-DC systems
PC farms
Routers

Examples of how to calculate energy costs for contract adjudications can be found in Annex 1

**Heat recovery systems and return on investment:**

CERN makes continuous efforts in view of reducing its energy consumption.

In case an asset would allow heat recovery that would be of interest to CERN (not less than 1 MW), the interfaces must be specified by CERN, as well as minimum amount of heat to be recovered. Bidders shall be requested to indicate the efficiency and the amount of heat to be recovered from their asset/system. CERN shall calculate the equivalent savings (gas consumption for heating for example) over a time period that will be defined during the Start-up meeting. The corresponding saved amount shall be considered as a deduction of the adjudication price.

After Contract signing, in case the delivered system is measured with a lower heat recovery value than mentioned in the bid, penalties shall be applied (typically the additional costs associated to production of the missing heat calculated over the lifetime of the project).

## Annex 1

### Examples

#### Example no 1: Procurement of Power Transformers

Estimated lifetime: 30 years/262 980 h

Energy cost imposed in tendering documents: 0.046 CHF/kWh

The cost of the capitalized losses is included in the price for the adjudication of the contract. The bidder shall give the contractual no-load losses ( $P_{Fe}$ ) and load losses ( $P_{Cu}$ ) to the tender form expressed in watts W.

The cost of the capitalized losses is calculated in Swiss francs according to this formula:

$$P_{CL} = P_{Fe} \cdot UCP_{Fe} + P_{Cu} \cdot UCP_{Cu}$$

Where:

$P_{CL}$	Price for capitalized losses in CHF;
$P_{Fe}$	No-load losses of the transformer in W;
$P_{Cu}$	Load losses at 120 °C of the transformer in W at 50% load;
$UCP_{Fe}$	Unit cost of no-load losses, 12.10 CHF/W;
$UCP_{Cu}$	Unit cost of load losses at 120 °C, 3.00 CHF/W.

#### **Calculation:**

##### **No load losses:**

$$UCP_{Fe} = \text{Number of hours in h} \cdot \text{Price per kWh in } \frac{\text{CHF}}{\text{kWh}}$$

$$UCP_{Fe} = 262\,980 \text{ h} \cdot 0.046 \frac{\text{CHF}}{\text{kWh}} = 12\,097 \frac{\text{CHF}}{\text{kWh}} = 12.10 \frac{\text{CHF}}{\text{W}}$$

##### **Load losses:**

Losses due to the load is proportional to the square of the load current. Load current in summer is 60% of the nominal current and in winter time 40% due to the technical stop. In average the load current is 50% of the nominal current.

So for each, guaranteed losses for the nominal load of 0.5 will cost:

$$UCP_{Cu} = \text{Number of hours in h} \cdot \text{Price per kWh in } \frac{\text{CHF}}{\text{kWh}} \cdot \text{Load Current Fraction}^2$$

$$UCP_{Cu} = 262\,980 \text{ h} \cdot 0.046 \frac{\text{CHF}}{\text{kWh}} \times 0.5^2 = 3\,024.27 \frac{\text{CHF}}{\text{kWh}} = 3.00 \frac{\text{CHF}}{\text{W}}$$

The cost of energy for the no-load and load losses shall be added to the total FCA price.

**Example no 2: Procurement of UPS systems**

Operation Time: 10 years/87 600 h

Energy cost: 0.14 CHF/kWh

Number of UPS systems: 40 units

Bidders shall provide power losses W for one UPS system, in the following operational conditions:

- AC input supply present and having nominal voltage and frequency;
- 20°C ambient temperature;
- Rectifier modules DC output voltage equal to the battery floating voltage specified by the battery manufacturer for 20°C;
- Rectifier modules delivering 50% of the rated active power.

**Calculation:**

The energy losses cost, for all UPS systems, is calculated for the estimated operation time of 87 600 h, as follows:

$$\begin{aligned} &\text{Energy losses cost in CHF} \\ &= \text{Power Loss in kW} \cdot \text{Number of systems} \cdot \text{Energy costs in } \frac{\text{CHF}}{\text{kWh}} \\ &\cdot \text{Operation Time in h} \end{aligned}$$

$$\text{Energy losses cost in CHF} = 0.2892 \cdot 40 \cdot 0.14 \cdot 87\,600 \text{ CHF} = 141\,869.95 \text{ CHF}$$

The energy losses cost shall be added to the total FCA price for adjudication.