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**Guide for procurement of power station equipment - Part 4-10: Boilers auxiliaries - Flue gas denitrification (De-NOx) plant**

Guide for procurement of power station equipment -- Part 4-10: Boiler auxiliaries - Flue gas denitrification (De-NOx) plant

Leitfaden für die Beschaffung von Ausrüstungen für Kraftwerke -- Teil 4-10: Nebenanlagen - Rauchgas-NOx-Minderungsanlage (DeNOx)

Guide pour l'acquisition d'équipements destinés aux centrales de production d'électricité -- Partie 4-10: Auxiliaires de chaudière - Installation de dénitrification des fumées (DéNOx)

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**Ta slovenski standard je istoveten z: EN 45510-4-10:1999**

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**ICS:**

13.040.40	Emisije nepremičnih virov	Stationary source emissions
27.060.30	Grelniki vode in prenosniki toplote	Boilers and heat exchangers
27.100	Elektrarne na splošno	Power stations in general

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EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

EN 45510-4-10

October 1999

ICS

English version

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Boiler auxiliaries - Flue gas denitrification (De-NOx) plant

Guide pour l'acquisition d'équipements destinés aux  
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Kraftwerke - Teil 4-10: Nebenanlagen - Rauchgas-NOx-  
Minderungsanlage (DeNOx)

This European Standard was approved by CEN/CENELEC on 1 October 1999.

CEN/CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN/CENELEC member.

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Contents		Page
<b>Foreword</b>		<b>4</b>
<b>1 Scope</b>		<b>6</b>
<b>2 Normative references</b>		<b>6</b>
<b>3 Definitions</b>		<b>6</b>
3.1	Organisational terms	7
3.2	Technical terms	7
3.3	General terms	8
<b>4 Brief overall project description</b>		<b>9</b>
4.1	Role and organisation of purchaser	9
4.2	Site location	9
4.3	Equipment task	9
4.4	Equipment to be purchased	9
4.5	Control and instrumentation	10
4.6	Electrical supplies and other services	10
4.7	Other interfaces	10
4.8	Project programme	10
4.9	Equipment identification systems	10
<b>5 Extent of supply</b>		<b>11</b>
<b>6 Terminal points</b>		<b>12</b>
<b>7 Operational requirements</b>		<b>12</b>
7.1	Operating environment	12
7.2	Manning levels	12
7.3	Normal operation	12
7.4	Operating hours	12
7.5	Start-up and shut-down	12
7.6	Abnormal conditions	13
7.7	Further operational requirements	13
<b>8 Life expectancy</b>		<b>13</b>
8.1	Design life	13
8.2	Components requiring periodic maintenance	14
<b>9 Performance requirements</b>		<b>14</b>
9.1	Duty	14
9.2	Performance	15
9.3	Equipment margins	15
9.4	Availability	16
9.5	Levels of component redundancy	16
9.6	Further performance requirements	16
<b>10 Design and fabrication</b>		<b>16</b>
10.1	Specific equipment features	16
10.2	Design justification	17
10.3	Material selection	17
10.4	Safety	18
10.5	Interchangeability	18
10.6	Fabrication methods	18
<b>11 Maintenance requirements</b>		<b>18</b>
11.1	Planned maintenance	18
11.2	Personnel safety	18
11.3	Requirements for access	18
11.4	Lifting requirements	18
11.5	Special tools	19
11.6	Test equipment	19
11.7	Spare parts strategy	19

11.8	Special precautions.....	19
12	Technical documentation requirements .....	19
12.1	Tender documentation.....	19
12.2	Contract documentation.....	19
13	Applicable legislation, regulations, standards and further requirements .....	20
13.1	Legislation and regulations .....	20
13.2	Standards.....	20
13.3	Further requirements .....	20
14	Evaluation criteria .....	20
14.1	General .....	20
14.2	Technical criteria.....	21
15	Quality measures.....	21
15.1	General .....	21
15.2	Approvals procedure.....	21
15.3	Inspection requirements .....	21
15.4	Non-conformity .....	22
16	Site factors .....	22
16.1	Access .....	22
16.2	Facilities .....	22
16.3	Site specific requirements.....	22
17	Verification of specified performance .....	23
17.1	General .....	23
17.2	Works tests.....	23
17.3	Test during installation and commissioning.....	23
17.4	Technical conditions for trial run .....	23
17.5	Functional and performance tests .....	23
Bibliography .....	25	

<https://standards.iteh.ai/catalog/standards/sist/en-45510-4-10-2000/54fe649d1b2f/sist-en-45510-4-10-2000>

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## Foreword

*This European Standard has been prepared by Technical Committee CEN/CLC JTFPE "Joint Task Force Power Engineering", the secretariat of which is held by BSI.*

*This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2000, and conflicting national standards shall be withdrawn at the latest by April 2000.*

*According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.*

*This standard takes the form of a recommendation and is therefore entitled a "Guide".*

*This Guide for procurement has been prepared under mandates given to CEN and CENELEC by the European Commission and the European Free Trade Association.*

*This Guide for procurement is a part of a series of Guides mandated to cover the procurement of power station plant and **equipment** in conformity with European Procurement Directives. The Guides are:*

**EN 45510 Guide for procurement of power station **equipment****

**Part 1: Common Clauses**

**Part 2-1: Electrical equipment - Power transformers**

**Part 2-2: Electrical equipment - Uninterruptible power supplies**

**Part 2-3: Electrical equipment - Stationary batteries and chargers**

**Part 2-4: Electrical equipment - High power static converters**

**Part 2-5: Electrical equipment - Motors**

**Part 2-6: Electrical equipment - Generators**

**Part 2-7: Electrical equipment - Switchgear and control gear**

**Part 2-8: Electrical equipment - Power cables**

**Part 2-9: Electrical equipment - Cabling systems**

**Part 3-1: Boilers - Water tube boilers**

**Part 3-2: Boilers - Shell boilers**

**Part 3-3: Boilers - Boilers with fluidized bed firing**

**Part 4-1: Boiler auxiliaries - Equipment for reduction of dust emissions**

**Part 4-2: Boiler auxiliaries - Gas-air, steam-air and gas-gas heaters**

**Part 4-3: Boiler auxiliaries - Draught plant**

**Part 4-4: Boiler auxiliaries - Fuel preparation equipment**

**Part 4-5: Boiler auxiliaries - Coal handling and bulk storage plant**

**Part 4-6: Boiler auxiliaries - Flue gas desulphurisation (De-SO<sub>x</sub>) plant**

**Part 4-7: Boiler auxiliaries - Ash handling plant**

**Part 4-8: Boiler auxiliaries - Dust handling plant**

**Part 4-9: Boiler auxiliaries - Sootblowers**

**Part 4-10: Boiler auxiliaries - Flue gas denitrification (De-NO<sub>x</sub>) plant**

**Part 5-1: Turbines - Steam turbines**

**Part 5-2: Turbines - Gas turbines**

**Part 5-3: Turbines - Wind turbines**

**Part 5-4: Turbines - Hydraulic turbines, storage pumps and pump-turbines**

**Part 6-1: Turbine auxiliaries - Deaerators**

**Part 6-2: Turbine auxiliaries - Feedwater heaters**

**Part 6-3: Turbine auxiliaries - Condenser plant**

**Part 6-4: Turbine auxiliaries - Pumps**

**Part 6-5: Turbine auxiliaries - Dry cooling systems**

**Part 6-6: Turbine auxiliaries - Wet and wet/dry cooling towers**

**Part 6-7: Turbine auxiliaries - Moisture separator reheaters**

**Part 6-8: Turbine auxiliaries - Cranes**

*Part 6-9: Turbine auxiliaries - Cooling water systems*

*Part 7-1: Pipework and valves - High pressure piping systems*

*Part 7-2: Pipework and valves - Boiler and high pressure piping valves*

*Part 8-1: Control and instrumentation*

*EN 45510 part 1 contains those clauses common to all the above Guides giving the provisions of a non **equipment** specific nature for use in the procurement of power station plants. EN 45510 is the responsibility of JTFPE. The so called "common clauses", as appropriate, also appear in italics in the documents specific to particular **equipment**.*

*In this Guide, words in bold type indicate that they have the meaning given in the definitions, clause 3.*

In this Guide, words and sentences not in italics are specific to this Guide and refer to the particular **equipment** covered.

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## 1 Scope

*This standard gives guidance on writing the technical **specification** for the procurement of processes and equipment for the removal of **nitrogen oxides** from the **flue gas** of steam generating plant for use in electricity generating stations (power stations). This Guide for procurement is not applicable to **equipment** for use in the nuclear reactor plant area of nuclear power stations. Other possible applications of such **equipment** have not been considered in the preparation of this Guide.*

This Guide covers:

- Selective Catalytic and Selective Non-Catalytic Reduction Systems (SCR and SNCR);
- systems to meet specific **flue gas nitrogen oxide** discharge requirements;
- systems applying different types of ammonia-based solutions as **reagent**;
- systems applying urea or compounds containing NH radicals as a **reagent**.

*The **equipment** covered by this Guide is defined by its function rather than design type. Therefore, the guidance to the **specification** is stated in performance terms rather than being specified by a detailed description of the **equipment** to be supplied.*

*This Guide indicates to potential **purchasers** how their **specification** should be prepared so that:*

- the **equipment** type and capacity interfaces correctly with other elements of the systems, particularly the boiler plant;
- predicted **performance** is achieved;
- ancillary equipment is properly sized;
- **reliability, availability** and safety requirements are achieved;
- proper consideration is given to the evaluation process and the quality measures to be applied.

*This Guide does not determine the type of **specification** (e.g. detailed, performance, functional) or the extent of supply for any given contract which is normally decided on the basis of the **purchaser's** project strategy. It does not cover:*

- any commercial, contractual or legal issues which are normally in separate parts of an **enquiry**;
- any allocation of responsibilities which are determined by the contract.

*This Guide does not prescribe the arrangement of the documents in the **enquiry**.*

*NOTE: As a comprehensive European environmental policy is still under preparation, this Guide does not address the environmental implications of the **equipment**.*

## 2 Normative references

*This Guide for procurement incorporates by dated or undated reference, provisions from other publications. These normative references are cited in the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this Guide only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.*

EN ISO 9001	Quality systems - Model for quality assurance in design, development, production, installation and servicing (ISO 9001:1994).
EN ISO 9002	Quality systems - Model for quality assurance in production, installation and servicing (ISO 9002:1994).
IEC 60050-191	International electrotechnical vocabulary – Chapter 191 : Dependability and quality of service.

## 3 Definitions

*For the purposes of this Guide, the following definitions apply:*



### 3.1 Organisational terms

**3.1.1 purchaser:** Recipient of a product and/or a service provided by a **supplier**.

**3.1.2 supplier:** Person or organisation that provides a product and/or a service to the **purchaser**.

**3.1.3 specification:** Document stating technical requirements of the **purchaser**. It may form part of an **enquiry** issued by a **purchaser**.

**3.1.4 enquiry:** Invitation to **tender** issued by a **purchaser**. It will normally include a **specification** together with the necessary contractual and commercial conditions.

**3.1.5 tender:** Offer made by a **tenderer** in response to an **enquiry**.

**3.1.6 tenderer:** Person or organisation submitting a **tender** for the **equipment** in response to the **enquiry**.

**3.1.7 site:** Place to which the **equipment** is to be delivered or where work is to be done by the **supplier**, together with so much of the area surrounding as the **supplier** may, with the consent of the **purchaser**, use for the purposes of the contract.

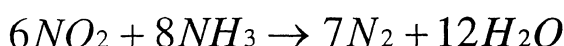
*NOTE: Further definitions of useful organisational terms may be found in EN ISO 8402 (see Bibliography).*

### 3.2 Technical terms

**3.2.1 denitrification plant (or De-NO<sub>x</sub> plant):** Equipment to remove nitrogen oxides (NO<sub>x</sub>) from the flue gas. This includes the equipment directly associated with the process and that providing a common service to several gas streams.

**3.2.2 nitrogen oxides (NO<sub>x</sub>):** Comprise the nitrogen oxides NO and NO<sub>2</sub>. The NO<sub>x</sub> concentration is expressed as vppm or as mg/Nm<sup>3</sup> calculated as NO<sub>2</sub> (1 vppm ≈ 2 mg/Nm<sup>3</sup> as NO<sub>2</sub>)

**3.2.3 process:** Chemical reaction for NO<sub>x</sub> reduction, for example, as described by the following equations;



Similar reactions occur with urea and other compounds containing NH radicals as reagents.

The degree of NO<sub>x</sub> reduction depends on the active surface, the flue gas flow distribution, temperature, residence time in the reaction zone and the homogeneity of the reagent distribution.

**3.2.4 nitrogen oxide removal efficiency:**

$$\eta = \frac{N_i - N_o}{N_i}$$

Where:  $\eta$  is the **nitrogen oxide removal efficiency**, expressed as a percentage;

$N_i$  is the inlet NO<sub>x</sub> concentration;

$N_o$  is the outlet NO<sub>x</sub> concentration.

**3.2.5 flue gas :** Mixture of gases resulting from the combustion process and other gases entering the induced draught system (i.e. air ingress or cross-leakage).

**3.2.6 inlet or untreated gas:** Gas to be treated by the **process**, normally defined in terms of volumetric or mass flow rate, temperature, pressure and composition. The latter may be expressed on an actual or reference basis (e.g. mg/Nm<sup>3</sup> at 6% O<sub>2</sub> by volume in dry gas).

**3.2.7 outlet or treated gas:** Gas leaving the **process** after treatment, defined in terms of volumetric or mass flow rate, temperature, pressure and composition. The latter may be expressed on actual or reference basis (e.g. mg/Nm<sup>3</sup> at 6% O<sub>2</sub> by volume in dry gas).

**3.2.8 ammonia slip:** Concentration of ammonia in the **outlet gas** stream from the denitrification **process** reaction zone. The figures are normally expressed in terms of vppm.

**3.2.9 catalyst activity:** Effectiveness of a catalyst in achieving **NO<sub>x</sub>** reduction. It is determined by measuring the **NO<sub>x</sub>** reduction over a catalyst element.

$$k = -\frac{V_f}{S_c} \cdot \ln(1 - \eta)$$

Where:  $k$  is the **catalyst activity** (m/h);  
 $\eta$  is the **nitrogen oxide removal efficiency**;  
 $V_f$  is the gas flow through the catalyst (m<sup>3</sup>/h);  
 $S_c$  is the surface area of the catalyst (m<sup>2</sup>).

**Catalyst activity** reduces over its operating life and varies significantly with the prevailing operating conditions. Therefore the actual **catalyst activity**  $k_a$  is measured at intervals using defined operating conditions (i.e. inlet gas composition, temperature, flow rate and **reagent** injection rate) at used elements and compared with the **catalyst activity**  $k_o$  of new elements.

**3.2.10 reagent:** Reducing chemical necessary for the **process** to occur.

**3.2.11 additive:** Chemical compound extending the temperature range within which the reducing reaction can occur.

**Additives** are often called enhancers for Selective Non-Catalytic Reduction (SNCR) **processes**.

**3.2.12 waste disposal components:** The components from the **process** for which additional processing or special disposal methods are required. In SCR (Selective Catalytic Reduction) **De-NO<sub>x</sub> plant** this is the replaced catalyst which is no longer sufficiently active.

**3.2.13 flue gas booster fan:** Fan which provide additional pressure to compensate for head loss through **De-NO<sub>x</sub> plant**.

**3.2.14 damper:** Device in a duct which uses movable blades to regulate the flow of gas. If used as an isolation device its effectiveness is defined, when shut-off, in terms of the leakage flow rate expressed as a percentage of the maximum flow rate when the damper is open.

**3.2.15 turndown:** Ratio of continuous maximum to minimum operating condition, for example a **turndown** ratio of 4:1 means that the **equipment** should be capable of operating from 100% down to 25% of the flow rate at the **continuous maximum operating condition**.

**3.2.16 continuous maximum operating condition:** Maximum condition at which the **equipment** may be operated for a period not exceeding the specified **design life**. This is the operating condition under which the performance tests are usually conducted.

### 3.3 General terms

**3.3.1 equipment:** Plant, component, system and/or associated service to be provided in response to the enquiry.

**3.3.2 conformity:** Fulfilment of specified requirements by a product, process or service.

**3.3.3 performance:** Obligations verified by specified tests.

**3.3.4 operating period:** Time between planned outages or maintenance periods during which the **equipment** is in operation and/or does not restrict operational requirements of the power station.

**3.3.5 life expectancy:** Time period over which the **equipment** might be expected to operate with planned maintenance but without replacement of a significant component.

**3.3.6 design life:** Operating hours of the **equipment** on which design calculations are based.

**3.3.7 acceptability:** Compliance with criteria defined by the **purchaser** for assessing the suitability of equipment.

**3.3.8 equipment margins:** Allowance for design, fabrication or operating contingency defined in the **specification**. These are separate to those normally included by the **supplier** for his own purposes.

**3.3.9 proven equipment:** Equipment which may be demonstrated to be similar to that offered and has operated for a sufficient time to have demonstrated performance and availability.

**3.3.10 availability:** As defined in IEC 60050-191.

**3.3.11 reliability:** As defined in IEC 60050-191.

**3.3.12 maintainability:** As defined in IEC 60050-191.

## 4 Brief overall project description

### 4.1 Role and organisation of purchaser

The **enquiry** should define the **purchaser's** role in the project, including whether the **purchaser** will assume responsibility for the planning and technical coordination of the project, or whether other organisations will be appointed to carry out all or part of this function. The **enquiry** should define all organisational interfaces and the procedures to be employed for managing the contract and the **site**.

### 4.2 Site location

The **specification** should describe the geographical location of the **site** which may include surveying points, the previous use of the **site** and any local features such as impact of industrial or military activities and planning restrictions.

Where applicable, the **specification** should indicate **site** datum on **specification** drawings and specify **site** and drawing orientation and define co-ordinate axes (x, y, z) and numbering order to ensure consistency between suppliers of connected equipment.

Where appropriate, the **specification** should define the permitted ground loading, dimensional and time restrictions on access routes up to but not including public roads or railways.

The **specification** should identify, where appropriate, the environment of the **site** in which the **equipment** will operate. The following factors may normally be included if appropriate:

- climatic e.g. atmospheric pressure, annual variation of air and cooling water temperature, relative humidity, rain fall, icing, snow, wind velocity (normal and maximum), lightning;
- geological e.g. seismic conditions and characteristics of subsoil (e.g. caverns, gliding stratifications, load bearing capability of subsoils);
- geographic e.g. elevation, influence of local topography and structures;
- hydrological e.g. flooding and tides.

### 4.3 Equipment task

The **specification** should describe in general terms the function, task or role of the **equipment** to be purchased, e.g. whether it is part of a new power generating plant, a modification to an existing power generating plant, or replacement **equipment**.

Where appropriate, the **specification** should define the function and the known limitations, if any, in the **equipment** connected to that which is being supplied so that the **equipment** may avoid imposing adverse conditions or the **supplier** may suggest modifications to connected equipment which would ensure satisfactory operation.

### 4.4 Equipment to be purchased

The **specification** may define the **equipment** type or arrangement to be purchased, for example a complete De-NO<sub>x</sub> plant, including all equipment for ammonia storage or a reactor with its associated services only.

The specification may also define, for example: