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PLANT NOISE CONTROL SPECIFICATION

Modifications to previous issue are marked with a right border

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1. SCOPE

The present specification establishes the engineering criteria for determining the maximum noise levels allowed in the Plant, taking into account the daily exposure of the operating personnel and defines the necessary measures to be taken to control the equipment noise levels when exceeding such values.

The criteria under the scope of the present document are applicable only to New Units.

The present document should be read in conjunction with:

- 079254C-0000-JSD-6000-02: Equipment Noise Specification

2. CODES AND STANDARDS

The following codes and standards, to the extent specified herein, form a part of this specification. When an edition date is not indicated for a code or standard, the latest edition shall apply.

a. Laws and Codes:

[1] Law No. 4 of 1994 amended by Law No. 9 of 2009 and Law N° 105 of 2015 and its Executive Regulations (ER) issued by the Prime Minister's Decree No. 338 of the 1995 amended by Prime Minister's Decree No. 710 of 2012 and Prime Minister's Decree No. 618 of 2017.
[2] IFC EHS General Guidelines (April 30, 2007)

b. Criteria and Procedures:

Engineering Equipment and Materials Users Association – EEMUA

[3] EEMUA 140: Noise Procedure Specification
[4] EEMUA 141: Guide to the Use of EEMUA 140

c. Measuring Instruments will be in Accordance with:

International Electrical Commission – IEC

[5] IEC 61672: Sound Level Meters, Part 1 & 2
[6] IEC 60225: Octave, Half – Octave and Third – Octave Band Filters Intended for the Analysis of Sound and Vibrations
[7] IEC 60942: Sound Level Calibrators

d. Measuring methods will be in accordance with:

International Standard Organization – ISO

[8] ISO 9612: Acoustics – Determination of Occupational Noise Exposure

[9] ISO 1996: Engineering Method
Acoustics – Description, Measurement and Assessment of Environmental Noise, Part 1 & 2.

3. DEFINITIONS

The following terms as used in this specification shall have the meanings denoted:

Noise:
Any unwanted sound which can produce, at least potentially, undesirable effects or reactions in humans.

Noise Level:
The sound level or sound pressure level of a sound which is categorized as noise.

Sound Pressure Level (SPL):
The sound pressure level is an indication of the loudness of a noise and it is the quantity measured by sound level meters. The sound pressure level is expressed in decibels (dB) and is defined as follows:

$$SPL = 20 * log_{10} \frac{P}{P_o}$$

Where:
SPL = Sound Pressure Level (dB)
P_o = Reference Sound Pressure, $2*10^{-5}$ N/m^2 (1 N/m^2 = 1 Pa)
P = Sound Pressure (N/m^2)

Sound Power:
The sound power is a measure of the acoustic power, measured in watts and emitted by a source.

Sound Power Level (PWL):
The sound power level is expressed in decibels (dB) and is defined as follows:

$$PWL = 20 * log_{10} \frac{W}{W_o}$$

Where:
PWL = Sound Power Level (dB)
W_o = Reference Sound Power, 10^{-12} W
W = Sound Power (W)

Sound Level:
The sound pressure level when frequency-weighted according to the standardized A or C reference scales used in sound-level meters.

dB(A):
The sound level which is measured on the A-weighted scale of a sound-level meter. The A-weighted scale represents closely the sensibility of the human ear.

Band Level:
The sound pressure level in a particular frequency band, for example, the 500 Hz octave band level.

Narrow Band Noise:
When the noise from a source contains a pure tone or narrow band component which is a noticeable to ear as a noise of distinguishable pitch, and which represents a dominant feature of the total source noise, then the source noise shall be regarded as containing narrow band noise for the purpose of this specification.

Background Noise:
The noise without a particular source of emission.

Impulsive Noise:
When a noise contains significant irregularities, such as bang, clanks, or thumps, or if the noise is only existent momentarily and is of a character to attract attention, the it shall be considered as impulsive for the purpose of this specification.

Work Area:
The work area is defined as any position greater than 1 m from equipment surface (including piping systems) which is accessible to personnel, or any position where a person's ear may be exposed to noise, during normal work activities up to 8 h/day.

Restricted Area:
Restricted areas are those areas in the plant where it is not reasonably possible to reduce the noise level below the work area limit. In those areas, the presence of operators without hearing protection shall be maximum 2 h/day.

4. PERMISSIBLE EXPOSURE LIMITS

The here below listed values indicates the permissible noise limits and time of exposure.

Table 1 – Permissible Noise Limits Depending on Time of Exposure

Daily Exposure, T_n (h)	Sound Level, C_n (dB(A))
16	82
8	85
4	88
2	91
1	94
½	97
¼	100

It is to be noted that when the daily exposure is composed of various periods of exposure, a combination effect should be considered rather than the individual effects of each period, applying the following formula:

$$\frac{C_1}{T_1} + \frac{C_2}{T_2} + \cdots + \frac{C_n}{T_n} < 1$$

Where:
C_n = actual exposure time at a certain sound level, but ≥ 80 dB(A).
T_n = allowed exposure time at the same sound level.

In case the sum of the various fractions exceeds the unit, then, the combined effect should be considered exceeding the maximum permissible noise limits.

5. NOISE LEVELS IN PLANT

5.1. General Field Operation

During the normal operating conditions, the noise level shall not exceed the value of 85 dB(A) and shall be applied to the whole general field area, except within a restricted area.

5.2. Restricted Area

The noise level inside restricted area shall not exceed the value of 91 dB(A) during normal operating conditions (2 hour/day without hearing protection).

Permanent warning signs to indicate the mandatory use of ear protectors shall be erected at the boundaries of restricted areas.

5.3. Absolute Noise Limits

Employee shall not be exposed to steady sound levels in excess of 115 dB(A) during normal Plant operation, regardless of the time duration. Employees shall not be exposed to impulsive or impact noise in excess of 135 dB peak sound pressure level.

5.4. Noise levels in Buildings

Noise levels during new facilities operation shall not exceed the values shown in Table 2, according to the Egyptian Law (Ref. [1]).

Table 2 - Permissible Limits of Noise Levels Inside Places of Work and Indoor Places		
Type of Place/Activity	**Maximum limit dB(A)**	**Exposure duration (h)**
Offices, work rooms for computers or similar equipment	65	-
Work rooms for activities that require routine mental concentration. Control rooms for industrial activities, cafeterias and restaurants.	60	-

5.5. Maximum Noise Level at Fence

With reference to noise level to be not exceeded at fence, the limit selected is the one indicated in Egyptian Regulation [1] relevant to “Industrial area” which is 60 dB(A) night time and 70 dB(A) day time.
If existing noise values at fence line are greater than the 70 / 60dB (A) (already at the permissible limit), the noise level increase due to contribute of new Units in Early Works scope of work shall be not greater than of 3 dB(A).

6. NOISE PREVENTION AND CONTROL

6.1. General

In order to maintain the noise of the plant within allowed limits, the following steps should be undertaken:

a. Analysis of the single noise sources, like:

- Compressors,
- Pumps,
- Motors,
- Reduction Gears,
- Fans and Blowers,
- Mixers,
- Heaters,
- Control Valves in gaseous service with critical pressure drops,
- Continuous vents,
- Ejectors,
- Pipes with high speed fluids

b. Analysis of superimposition of the various effects from the single noise sources
c. Definition of the sound proofing actions on each noise source in relation to the typology of the source and its location in the plant.

6.2. Noise Data

In case of equipment not exceeding 75 dB(A) at 1 m, the supplier may only submit his confirmation without specifying the noise levels at various octave bands.

Generally, the following equipment have demonstrated to operate below the above limits:

- Mechanical agitators < 10 HP
- Pumps:
  - Centrifugal < 20 HP
  - Gear < 20 HP
  - Reciprocating < 10 HP
  - Proportioning All
- Control Valves:
  - Closed piping systems with subsonic flow
  - Liquid service

6.3. Superimposition

Based on the various information received by the suppliers, a superimposition analysis will be performed to evaluate if critical areas are deriving from the combination of noise sources which separately were within acceptable limits.

6.4. Sound Proofing

Noise reduction will be obtained by various and different methodologies as follows:

- As general rule, the designer will take care of the problem from the initial project stage. Particular attention will be paid to the positioning of the noisy equipment in the detailed units plot plans. Whenever feasible, effects of superimposition will be avoided.
  Extremely noisy machines will be segregated from the rest of the plants as far possible and consistently with process requirements.

- During project execution, the designer shall verify that proper sizing is applied to usually noisy equipment such as control valves, ejectors, blowers and similar.

- After completion of the noise analysis, the designer shall define the equipment, piping and valves to be insulated for noise reduction.
  Insulating materials and thickness to be installed will be listed and marked on the engineering documents, with details of insulation systems.

- Practical effective noise attenuation methods shall be recommended by the equipment supplier.
  Supplier shall either provide specific noise attenuation devices to be installed on the equipment proper or give recommendations on the criteria to be followed to reduce the negative influence of external factors to the noise phenomenon.