

GE Energy

# Power Generation Equipment and Other Factors Concerning the Protection of Power Plant Employees Against Noise in European Union Countries

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## Introduction

Noise has become an increasingly important subject in the matter of workers' protection and health. Hearing impairment has been identified as one of the major health issues for Power Plant Employees and Owners.

To address this concern, the European Union (EU) has developed a Directive, which establishes lower and upper Exposure Action Values. The Directive also establishes an upper Exposure Limit Value. These values are the average level of noise a worker is exposed to for an eight (8) hour time period. Power Plant Owners must take specific actions, for the protection of power plant Employees when the Employees' exposure to noise has reached these levels.

The current Directive (86-188 EC, issued December 5, 1986), will be replaced by Directive 2003-10 EC (the "New Directive"), no later than February 2006. Compared to the current Directive, the New Directive contains lower 8-hour exposure values for the lower and upper Exposure Action Values (thresholds for action), and establishes a lower Exposure Limit Value. See *Table 1* for a summary of the New Directive's limits and required actions.

In response to the requirements in the New Directive, Power Plant Owners in European Union countries are specifying lower limits for noise levels from the power generation equipment they are purchasing. In many cases, the noise levels that are specified by the Power Plant Owners are at or below the lower threshold for action specified in the Directive(s), and/or are specified as maximum allowable levels. While ensuring that the Directive(s) limits will be met, these noise level requirements are typically more restrictive than required to comply with the EU Directive(s), and impose considerable costs to the Power Plant Owners.

The purpose of this paper is to clarify the EU Directive requirements and explore the various

methods that can be used to ensure the health and safety of the Employee, while controlling the cost impact on the Power Plant Owners.

## Discussion

**The Directive includes two noise indicators:**

the daily personal exposure  $L_{ex,d}$  and the maximum unweighted instantaneous sound pressure  $P_{peak}$  (C weighted).

**The following formulas can be used to calculate an Employee's Exposure for an 8-hour period:**

$$L_{EX,8h} = L_{Aeq,Te} + 10 \log_{10} \frac{T_e}{T_0}$$

where

$$L_{Aeq,Te} = 10 \log_{10} \left\{ \frac{1}{T_e} \int_0^{T_e} \left[ \frac{P_A^2}{P_0^2} \right] dt \right\}$$

$T_e$  = Daily duration of a worker's personal exposure to noise (hr)

$T_0$  = 8 hr

$P_0$  = 20 mPa

$P_A$  = "A"-weighted instantaneous sound pressure in pascals (Pa) to which a person is exposed.

Calculation of a **daily 8-hour average** exposure would typically be used for employees who are exposed to a continuous/constant noise level (such as Operators who are in essentially the same location throughout their shift).

However, for employees who are involved in *"activities where daily noise exposure varies markedly from one working day to the next, Member States may, for the purpose of applying the exposure limit values and the exposure action values, use the weekly noise exposure level in place of the daily noise exposure level to assess the levels of noise to which workers are exposed, on condition that:*

Article 3	Article 3	Article 4	Article 5	Article 6	Article 7	Article 8	Article 9	Article 10
Exposure Limit Values	Exposure Action Values	Determination/ Assessment	Reduction	Protection	Limitation of Exposure	Info/Training	Consultation/ Participation	Health/ Surveillance
	Less than 80 dB(A)	General Requirement	General	Not Required	Not Required		General Requirement	Not Required
	80 dB(A)	General Requirement	General	Not Required	Not Required	Required	General Requirement	Not Required
	Above 80 or less than 85 dB(A)	General Requirement	General	Make Available*	Not Required	Required	General Requirement	Testing Available
	85 dB(A)	General Requirement	General	Use/ Required*	Not Required	Required	General Requirement	Testing Available
	Above 85 dB(A)	General Requirement	Specific	Use/ Required*	Not Required	Required	General Requirement	Testing & Doctor Evaluation Required
87 dB(A)**		General Requirement	Specific	Use/ Required*	Not Required	Required	General Requirement	Testing & Doctor Evaluation Required
Above 87 dB(A)**		General Requirement	Specific	Use/ Required*	Action Required	Required	General Requirement	Testing & Doctor Evaluation Required

No requirement on Customer  
 General requirement on Customer (not dependent on exposure level)  
 Specific requirement on Customer (dependent on exposure level)  
 \* Member State Derogations Possible  
 \*\* The exposure limit values take into account the attenuation provided by the individual hearing protectors worn by the workers. The exposure action values do not take account of the effect of such protectors.

**Table 1. Limit Values and Required Action—From Directive 2003-10 EC**

- a) *The weekly noise exposure level, as shown by adequate monitoring, does not exceed the exposure limit value 87 dB(A);*
- and
- b) *Appropriate measures are taken in order to reduce the risk associated with these activities to a minimum.”*

[Quoted from Directive 2003-10 EC, Article 3]

This would typically apply to employees such as Inspectors and Maintenance Personnel, whose responsibilities would normally require them to be in

several different areas of the Power Plant in any given time frame.

### Considerations

The two major factors in limiting exposure are the noise level an individual is exposed to, and the amount of time an individual is exposed to a particular level of noise. Each of these may be controlled in various ways.

Control of the exposure noise level may be achieved by:

- 1a) Reduction at the source

- 1b) Use of enclosures, barrier walls, etc.
- 1c) Use of hearing protection
- 1d) Designating high noise areas as restricted areas

Control of exposure time may be achieved by:

- 2a) Monitoring programs
- 2b) Varying shifts
- 2c) Varying job assignments
- 2d) Avoiding high noise areas

Specification of a maximum allowable level of noise from the source (equipment) takes only two of these control factors into consideration [*1a) Reduction at the source, and 1b) Use of enclosures, barrier walls etc.*]. These could be the most expensive methods of limiting exposure to noise. The most cost effective approach is a comprehensive noise program, incorporating a combination of the factors listed above.

### **Other factors having an impact on average exposure over an 8-hour period include:**

- a) The Exposure Action Values established in the New Directive are for an average exposure. For example, an individual could be exposed to levels of 82 dBA for 2 hours, 80 dBA for 4 hours and 76 dBA for 2 hours, and still fall under the New Directive's lower threshold requiring action (80 dBA average for 8 hours).
- b) Varying noise levels around complex equipment. Equipment designed to meet an 80 dBA average noise level will typically have many areas well below that level.
- c) Access to areas which are traditionally "High Noise". Such access is frequently not permitted during typical Power Plant operation activities for safety reasons.
- d) Many areas in a typical plant and on the "turbine island" (including "high noise" areas) require only occasional access, and may be designated as

requiring hearing protection for entrance.

- e) The exposure limit value (87 dBA) in the New Directive takes the attenuation provided by individual hearing protection into account when calculating the Employee's exposure. For example; if the Employee is exposed to a noise level of 90 dBA for an eight-hour shift, and is wearing hearing protection that provides 10 dBA of attenuation, his/her exposure equals 80 dBA for the eight-hour shift, and is well below the exposure limit.

### **Exposure Thresholds and Required Actions**

Table 1 shows the relationship between the New Directive's Exposure Thresholds, and the actions that must be taken by the Power Plant Owners at each threshold level.

A comparison of the required actions at the various Exposure Action Values reveals that the differences between actions, which must be taken at the lowest value vs. the highest value, are comparatively small as long as the Exposure Limit Value is not exceeded.

When Exposure Action Values are at the lower threshold and above, **Information and Training** are required.

When Exposure Action Values range between the lower and upper thresholds, **Hearing Protection and Testing** must be made available.

When the upper Exposure Action Value is reached, use of **Hearing Protection** is required.

**Note:** It is important to note that **Information and Training** is the only mandated action, until the upper Exposure Action Value has been reached (85 dBA averaged over an 8-hour period).

### **Average vs. Maximum**

The fact that the allowable exposure levels set forth in the Directive(s) are based on an *average* exposure over an 8-hour period is of particular significance.

When taking the following enumerated factors into consideration, it is logical to conclude that equipment generating an acceptable average noise level will enable the Power Plant Owners to ensure that an Employee's exposure does not exceed the permitted average 8-hour exposure level set forth in the New Directive:

- In most cases, an employee would not be in one position, within 1 meter of the operating equipment, for an entire 8-hour shift.
- Noise levels around complex equipment vary.
- Areas which are traditionally "high noise" are frequently access limited.
- Many areas in a typical plant and on the turbine island (including "high noise" areas) require only occasional access.

In contrast, a "maximum" noise level specification requires that no noise level, measured in accordance with accepted procedures, may be greater than the level guaranteed. This would include areas that may be inaccessible, and areas that are infrequently occupied.

In view of these facts, there is no significant advantage to be gained from a "maximum" specification.

In addition to the above, a recent internal market study has shown that 80% of the requested equipment guarantees in contracts for EU countries were average values versus 20% maximum guarantees. This indicates that many EU Power Plant Owners have reached similar conclusions, and intend to consider all factors when determining the equipment noise levels they will require.

### Conclusion

When reviewing the New Directive, it should be noted that there is no specification of the permitted noise levels of power generation equipment. The intent is to limit the exposure of the Employee to noise. As discussed herein, there are two major factors that have a bearing on an individual's average exposure

to noise over an 8-hour period (the noise level[s] the Employee is exposed to, and the duration of the exposure). In addition, there are several criteria that influence each of the major factors. The noise level of the power generation equipment is only one of these.

Consideration should also be given to the possibility that mitigation measures required to achieve very low, or maximum, noise levels may have a negative impact on the ability to access certain areas for maintenance purposes, and in some cases may have a negative impact on the performance of the equipment.

An optimum approach to compliance with the New Directive should include a combination of equipment generating an average noise level, and a comprehensive noise exposure management program. This will allow the Power Plant Owners to ensure the health and safety of their employees as specified in EU Directive 2003-10 EC, while minimizing cost and possible negative impact on maintainability and performance of the equipment.

It is recommended that a thorough analysis be conducted, including all of the factors, variables and considerations presented in this paper, when determining the power generation equipment noise levels that Power Plant Owners will require.

### Reference

1. "Directive 2003-10 EC of the European Parliament and of the Council of 6 February 2003", Official Journal of the European Union.