

## NOISE IN OFF-SHORE OPERATIONS

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### ABSTRACT

To study the effect of noise on off-shore workers, the Bahregan Complex, the oldest off-shore operation in Iran, was chosen. The survey consisted of plant visits, determination of the noisy places and noise measurement, study of working conditions, number of the workers exposed to the noise, spells of exposure per day and years of service, medical examination including audiometry, type of hearing protective devices used and conditions of use.

High noise levels were noted in pump stations, power plants and separator areas. In 9 out of 63 employees exposed to noise a partial hearing loss was detected by audiometry (14.2%). Among workers with up to ten years of service 4.5% had a hearing impairment but in workers with more than ten years of service the percentage rose to 36.8%. The higher incidence in this group can be attributed to a longer exposure to noise and to inappropriate protection against noise during their first years of service before the systematic hearing preservation programme that started about ten years ago in the Oil Industry of Iran was established. The considerable difference in the rate of hearing impairment noted in the two groups is suggestive of effectiveness of the hearing preservation programme.

Noise which is defined as "unwanted sound" disturbs the environment and when excessive, damages the hearing mechanism. This has been a well-known fact since times immemorial. The Old Testament tells us that Solomon who gained the reputation of being one of the wisest of mankind and had miraculous powers built the Temple in 950's B.C. The temple was considered as "Marvel amongst marvells" because neither inside nor in the premises outside was the least noise of the workers or the working instruments ever heard. In the second Book of Samuel there is a curious passage concerning this fantastic achievement. In this passage the emphasis is on the magic way Solomon solved the eternal problem of noise<sup>5</sup>.

The quotation illustrates well the extent of knowledge that the ancient generation had on the subject of noise and the supernatural power that one needed to combat its ill effects. Whilst in the past noise was almost limited to the sound produced by natural sources, today it is mainly a by-product of man's technological achievements.

Excessive exposure to noise may produce both physical and psychological disorders. The initial symptoms of noise exposure below the threshold of pain

are usually discomfort, headache, and a temporary hearing loss. If the exposure is allowed to continue over a period of years, gradual permanent hearing impairment may develop.

Equally as imperative and very likely more important than the physical effects are possible psychological effects. Psychological reactions, like physical responses involve a multiplicity of factors which vary with the characteristics of the sound (its intensity, frequency, intermittency) as well as the inappropriateness of the stimulus, interference with speech communications, and the unexpectedness of noise. The type of noise rather than its intensity, is usually the deciding factor influencing emotional reactions. A sudden scream, a grating piece of chalk, a dripping faucet etc. can provoke different yet characteristic emotional responses<sup>2,7</sup>.

Noise may reduce output and efficiency and cause fatigue possibly by talking loud or extra efforts caused by misunderstandings<sup>6</sup>. The three principal problems presented by excessive noise are: annoyance of community, interference with communication of speech and temporary or permanent hearing loss.

In this paper the discussion is limited to the long-term effects on hearing of the employees of Bahregan off-shore workers. The problem of noise in off-shore operations differs from similar operations on land due to metallic construction of the off-shore platforms and their special spatial characteristics.

#### SUBJECTS AND METHODS

To study the effect of noise on off-shore workers, among six affiliated oil companies operating in the Persian Gulf, the Bahregan Complex, the oldest off-shore operation in Iran, was selected. The survey consisted of plant visits, determination of the noisy places and noise measurement, study of the working conditions, number of the workers exposed to the noise, spells of exposure per working day and years of service, type of hearing protective devices used and conditions of use, medical examinations including audiometry and otoscopy.

The Bahregan Complex has two production platforms and 29 oil wells in the Persian Gulf, 17 wells are in use at the moment. The production platform Bahregan Sar has a daily oil production of 3 300 cubic meters and is fed by 7 wells, and Nowrooz with 3 000 cubic meter oil production per day is fed by 10 wells at the moment.

Each platform consists of a living platform and a production platform; Bahregan Sar has drilling platforms as well. The average number of workers in Bahregan Sar and Nowrooz is 27 and 21 respectively. They work 12 hours per day for 2 weeks work, one week of schedule, called satellite operation. During the two-week periods the employees work and live on the platforms. Besides these 48 employees, maintenance, wire line and well maintenance workers also participate in the off-shore activities of Bahregan, therefore in the survey 63 persons exposed to noise were studied and medically examined.

The main noise sources in Bahregan are machines and equipments such as pumps, turbines, compressors, generators etc., and gas and oil moving under high pressure in pipes and vessels. The study revealed that the noise is above the accepted safe limits in pump stations, power plants and separator areas.

During the 12-hour working day the workers are exposed to intermittent high level noise for 4–6 hours. In addition they are exposed to background noise during their stay on platforms and during regular transportation by aeroplanes and helicopters.

Table 1 shows noise levels in aeroplanes, helicopters and different workplaces of the two platforms. Occupational distribution of 63 employees involved in off-shore operation and exposed to noise is as follows: dresser and radio operator: 2; supervisor of power plants: 2; painter: 2; water plant operator: 3; maintenance fitter: 4; platform supervisor: 5; production operator (including

TABLE 1  
Noise level in various workplaces.

Place		dB	
Nowrooz production platform	Aeroplane	81	
	Helicopter	102	
	Living platform	Office	60–61
		Rest rooms	60–61
		Clinic	73
		Mess room and cinema	65–70
		Air condition unit	90–92
	Production platform	Work shop	81 (door open 84)
		Separators near gauges	77–91 Max 106
		Turbine and pumps	104–108
		Control room	71
		Generators	99
	Lower deck	83	
Bahregan Sar	Living platform	Office	60
		Rest rooms	63
		Clinic	63
		Mess room and cinema	62
		Kitchen (doors open)	70
	Drilling platform	72–76	
Production platforms	Control room	69	
	Turbines	95–105	
	Middle part	90–93	
	Control room	70 (door open 85)	
	Gas and oil pipes	111–113	
	Pump and motors	104 + vibration	

separator operator): 8; wire line and well maintenance worker: 11; turbine and pump operator: 26.

The hearing protective devices used consist of ear muffs and ear plugs. The workers in separator area and turbine and generator operators usually wear ear muffs.

### RESULTS

A medical examination of 63 employees revealed that 9 developed noise induced hearing loss (14.2%). Five workers had non-occupational hearing loss due to a chronic inflammation of the middle ear, scarring or perforation of ear drums as a result of previous infections. Among 44 workers with up to 10 years of service only 2 were involved, but in 7 out of 19 workers with more than 10 years of service occupational hearing loss was found.

Hearing impairment in high frequencies for the 9 occupationally exposed workers, their age, length of service, duration of exposure to noise and conditions of use of hearing protection devices are shown in Table 2.

The mean hearing levels of the workers under study are shown in Figures 1 and 2.

### DISCUSSION

The problem of noise has been under consideration and study since the establishment of Industrial Medical Services of Oil Industry of Iran in 1954, which began with determination of noisy places and noise measurement and surveys in different areas of the Oil Industry<sup>1</sup>. The systematic hearing preservation programme started in 1962 in Abadan<sup>3</sup> and in 1966 in the Oil Fields<sup>4</sup>. This programme with "Damage Risk Criteria" set at 85 dB for 8-hour continuous work consists of:

- Overall noise measurement in pertinent environment
- Reduction of noise when above critical level at its source as much as possible
- Use of enclosure or changes in the operation procedures etc., wherever practicable
- Greater emphasis on consideration of the latest standards for the specification and selection of equipments and plants and their design
- Personal protection of employees working in high level noise environment
- Health education programme including training programmes on the effects of noise and methods of protection in working places; the programme should be carried out in special sessions and should be included in widely expanded first aid training programmes of the employees
- Pre-employment audiometric examination of all new employees and periodic follow-up examinations at 12-24 month intervals for all exposed to high level noise.

The audiometric survey of off-shore workers of Bahregan showed a significant noise induced hearing loss in 14.2% of all the employees. Not a single case of hearing loss was detected in workers with 5 years or less service. Among workers with up to 10 years of service 4.5% had impaired hearing but in workers with more than 10 years of service the impairment was found in 36.8%.

The considerable difference in the rate of hearing impairment between the two groups can be attributed to longer exposure to high level noise and inappropriate protection against noise during their first years of service, before establishment of the hearing preservation programme.

The relative minimal hearing impairment in the first group is considered to be due to the failure to early recognize highly susceptible individuals to noise and to the failure of workers to use hearing protective devices either due to their unsuitability in the particular climatic conditions or to the lack of adequate indoctrination of exposed employees because of shortcomings of the health education programmes.

With expansion of industries and progress of technology, noise as the unwanted by-product, needs special consideration and the importance of a comprehensive hearing preservation programme becomes more evident. Industry is aware that such programmes are expensive and time consuming, but it has been proved that such efforts do pay dividends. In this way we not only fulfill our duties towards our fellow workers, but also acknowledge our moral responsibility of seeing that the retiring employee may enjoy his declining years and take pleasure in the sound of music.

TABLE 2  
Occupation, years of service, exposure to high level noise per day, condition of use of hearing protective devices and hearing impairment in nine workers with noise induced hearing loss (in dB).

Case No.	Occupation	Age	Service (years)	Exposure per day (hours)	Use of hearing protectives (years)	4 000 Hz		6 000 Hz	
						Right	Left	Right	Left
1	Turbine operator	59	18 (2 in drilling)	6	7	90	70	100	80
2	Water plant operator	46	17 (4 in water plant)	6	4*	50	50	40	35
3	General fitter	50	16	6	4	55	50	60	50
4	Power plant operator	56	15	6	6	55	45	55	50
5	Turbine operator	51	15	6	6	70	65	85	75
6	Separator operator	33	14	6	3	40	45	30	40
7	Well maintenance worker	49	13	6	11	45	45	30	35
8	Separator operator	31	6 (2 on land)	6	4	40	45	30	40
9	Platform supervisor	38	5	6	5	40	35	35	60

\*occasionally

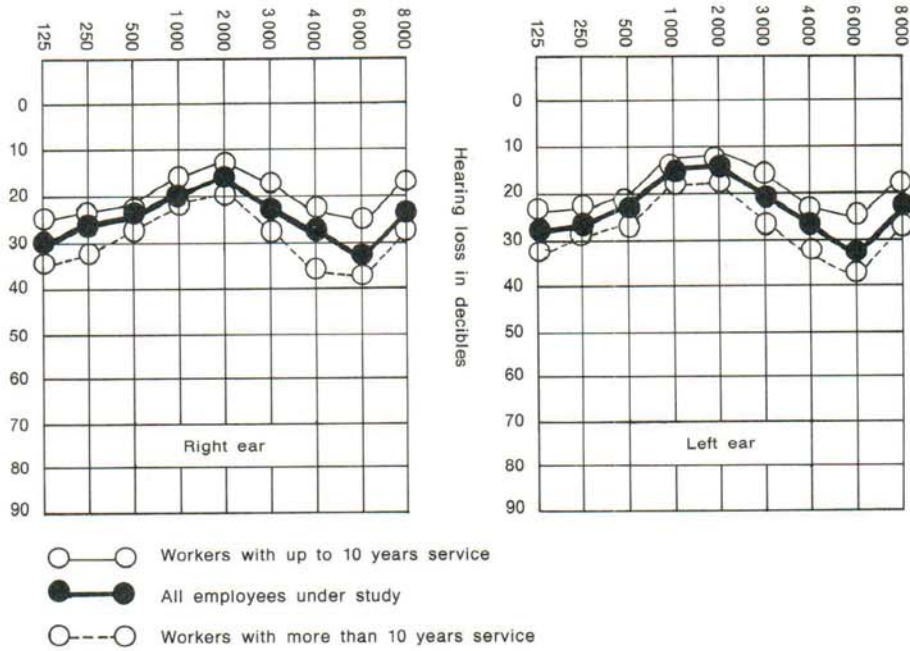


FIG. 1 - Mean audiogram of all Bahregan off-shore workers.

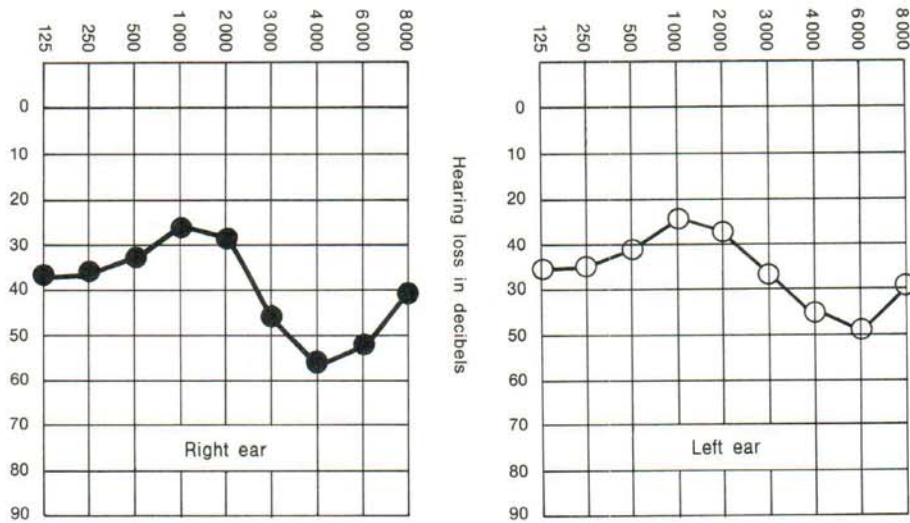


FIG. 2 - Mean audiogram of the 9 workers with noise induced hearing loss.

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