SINGLE PASS COLLIDER MEMO

SLAC-CN--266

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REPLACES CN#

TITLE: A SURVEY OF VIBRATION AMPLITUDES THROUGHOUT THE LINAC

Introduction:

The magnitude of vibrations of the Linac structure due to on site disturbances, such as cooling towers, pumps, generators, Highway 280 overpass traffic, is of interest. CN-263, for example, discusses tolerances of random (i.e., uncorrelated) quad jitter and suggests that amplitudes should not exceed 0.7 microns rms. This note describes the results of a series of measurements carried out in the summer of 1983. In general, the tolerance is not exceeded, but there appears to be a good safety factor at low frequencies.

Method:

Vibration measurements were done throughout the beam housing. (See Figure 1.) In order to detect the vibration through the Linac, three velocity transducers (geophones) were used. Two to pick up the vertical vibrations and one to pick up the horizontal NS (north-south) component, and horizontal EW (east-west) component. These instruments were connected to a Nicolet 660A Fast Fourier transform analyser giving an RMS spectrum of velocity versus frequency from 0 - 100 Hz. This experiment was started in Sector-30 and ended at Sector-1. See Table I, below, for location of instruments.

TABLE I

*	*	*	*	*	*	*
* SECTORS WHERE	* LOCATION A	LOCATION B				
* DATA WAS	*	*	*	*	*	*
* GATHERED	* VERTICAL	* VERTICAL	* HORIZONTAL			
*	* TRANSDUCER	* TRANSDUCER	* NS & EW			
*	*	*	*	*	*	*

*	*	*	*	*	*	*
* 30	* X	* X	* X			
* 29	* X	* X	* X			
* 28	* X	* X	* X			
* 27	* X	* X	* X			
* 26	* X	* X	* X			
* 25	* X	* X	* X			
*	*	*	*			
* 21	* X	* X	* X			
*	*	*	*			
* 18	* X	* X	* X			
*	*	*	*			
* 15	* -	* X	* X			
*	*	*	*			
* 9	* -	* X	* X			
*	*	*	*			
* 5	* -	* X	* X			
*	*	*	*			
* 1	* -	* X	* X			
*	*	*	*			

Note: X = yes instrument

- = no instrument

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From the recorded data, the displacements were then calculated as follows. Noting that:

$$\begin{aligned}\text{Velocity} &= X_0 W \sin(wt) \\ \text{Displacement} &= X_0 \cos(wt)\end{aligned}\quad \begin{aligned}X_0 &= \text{displacement amplitude} \\ w &= \text{natural frequency} \\ t &= \text{time}\end{aligned}$$

Thus: $\text{Displ.} = \text{Velo}/(2 f)$ where f = frequency

Figures 2-5 depict the vertical displacements versus sector on the Sinac, at either location A or B.

Figures 6-9 depict the horizontal (NS & EW component) displacement versus sector on the Linac at location B.

The discrete frequencies listed are those belonging to identifiable peaks in the spectra.

Conclusion:

In observing all the figures above, all displacements are below ~1.0 microns peak-to-peak, except for the vertical 8.25 Hz on Figure 3. This disturbance appears highest in the vicinity of Sector-5 with a peak-to-peak displacement amplitude of 2 microns. The source of this vibration has not yet been identified.

Highway 280's overpass around Sector 26-27 shows no apparent increase in vibration level on the Linac housing at the time of measurement. The two cooling towers at Sector 9-2 and Sector 22-4 also exhibit no increase in vibration level due to their operation on the Linac housing. Generally, the vertical amplitudes are higher than the horizontal and disturbances at lower frequencies predominate.

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Fig. 1

LOCATION OF Velocity Transducers
ON LINAC HOUSING

Location A' = Loc. of Vertical Velocity transducer = 5 ft. (P-1)

Location B' = Loc. of Vertical + Horizontal: NS, EW : Velocity transducer = 25 ft (P2)

note - Drawing - NOT TO SCALE

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Fig. 6

Fig. 7

Fig. 8

Fig. 9