

CLAUSE NO.	TECHNICAL REQUIREMENTS																		
12.00.00(E)	Annexure-(E)																		
	CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT All structures and equipment shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS:1893 (Part 1 to Part 4). Pending finalization of Part 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for embankments. Site specific seismic study has been conducted for the project sites. The peak ground horizontal acceleration for the project sites, the site specific acceleration spectral coefficients (in units of gravity acceleration 'g') in the horizontal direction for the various damping values and the multiplying factor (to be used over the spectral coefficients) for evaluating the design acceleration spectra are as given at Appendix-I (Project-wise). Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values. The site specific design acceleration spectra shall be used in place of the response acceleration spectra, given at figure-2 in IS:1893 (Part 1) and Annex B of IS:1893 (Part 4). The site specific acceleration spectra along with multiplying factors specified in Appendix-I includes the effect of the seismic environment of the site, the importance factor related to the structures and the response reduction factor. Hence, the design spectra do not require any further consideration of the zone factor (Z), the importance factor (I) and response reduction factor (R) as used in the IS:1893 (Part 1 to Part 4). Damping in Structures The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for: <table><tr><td>a)</td><td>Steel structures</td><td>:</td><td>2%</td></tr><tr><td>b)</td><td>Reinforced Concrete Structures</td><td>:</td><td>5%</td></tr><tr><td>c)</td><td>Reinforced Concrete Stacks</td><td>:</td><td>3%</td></tr><tr><td>d)</td><td>Steel stacks</td><td>:</td><td>2%</td></tr></table>				a)	Steel structures	:	2%	b)	Reinforced Concrete Structures	:	5%	c)	Reinforced Concrete Stacks	:	3%	d)	Steel stacks	:
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GADARWARA STPP STAGE-II (2X800MW) TELANGANA STPP STAGE-II (3X800MW) NABINAGAR STPP STAGE-II (3X800MW) BULK BTG PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC. NO.: CS-8014/9592/0371-001A-2	SUB-SECTION-D-1 CIVIL WORKS ANNEXURES	PAGE 1529 OF 1545															

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	Method of Analysis Since most structures in a power plant are irregular in shape and have irregular distribution of mass and stiffness, dynamic analysis for obtaining the design seismic forces shall be carried out using the response spectrum method. The number of vibration modes used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass and shall also meet requirements of IS:1893 (Part 1). Modal combination of the peak response quantities shall be performed as per Complete Quadratic Combination (CQC) method or by an acceptable alternative as per IS:1893 (Part 1). In general, seismic analysis shall be performed for the three orthogonal (two principal horizontal and one vertical) components of earthquake motion. The seismic response from the three components shall be combined as specified in IS:1893. The spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the structure falls to the left of the peak in the spectral acceleration curve. For buildings, if the design base shear (V_B) obtained from modal combination is less than the base shear ($\bar{V}_B$) computed using the approximate fundamental period (T_a) given in IS:1893:Part 1 and using site specific acceleration spectra with appropriate multiplying factor, the response quantities (e.g. member forces, displacements, storey forces, storey shears and base reactions) shall be enhanced in the ratio of $\bar{V}_B/ V_B$. However, no reduction is permitted if $\bar{V}_B$ is less than V_B. Design/Detailing for Ductility for Structures The site specific design acceleration spectra is a reduced spectra and has an in-built allowance for ductility. Structures shall be engineered and detailed in accordance with relevant Indian/International standards to achieve ductility.			
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