APPENDIX F
DESIGN AND ANALYSIS REQUIREMENTS
FOR SEISMIC EVALUATION REPORTS

The following outline summarizes the reporting requirements for seismic design and evaluation studies for both standard seismic studies and site-specific seismic studies as described in paragraph 5*h*. These are **minimum requirements** and should be supplemented as needed on a case-by-case basis.

A. Summary of Applicable Seismic Criteria
  1. Hazard potential classification from Table B-1 (Include consequences of project failure)
  2. Uniform Building Code seismic zone from map in Appendix C
  3. Design earthquakes
     a. MCE
     b. MDE
     c. OBE
     d. For each design earthquake provide:
        (1) PGA, PGD, PGV
        (2) Duration
        (3) Response spectra
  4. Critical project features (See paragraph 5*a*)
  5. Impact of seismic loads on project design (for new designs)
  6. Impact of seismic loads on project safety (for existing projects)

B. Description of Seismic Design or Evaluation Procedure
  1. Progressive seismic analysis process
  2. Input motions used in the analysis
  3. Loading combinations analyzed
  4. Modeling techniques used for:
     a. Structure
     b. Substructure
     c. Reservoir
     d. Backfill or sediment
  5. Material assumptions
     a. Mass
     b. Stiffness
     c. Damping
  6. Computer programs used in the analysis
     a. Dynamic analysis programs
     b. DSHA and PSHA ground motion programs
     c. Soil column effects programs

C. Presentation of Results of Ground Motion Studies
  1. Standard spectra used for preliminary studies and/or final designs
  2. DSHA site-specific response spectra
     a. Design response spectra
     b. MCE (Mean)
     c. MCE (84th percentile)
  3. PSHA site-specific response spectra. Equal hazard mean spectra for return periods of:
        72 years
       144 years
       475 years
       950 years
     2,000 years

5,000 years
10,000 years
4. Time-history records
   a. Natural time-history records used for final design
   b. Synthetic time-history records used for final design (Natural time-histories modified to match target design response spectrum analysis)
   c. Natural time-history scaling procedures
   d. Synthetic time-history development procedures
   e. Comparison of time-histories with design response spectra

D. Results of Dynamic Analysis
1. Periods of vibration
2. Mode shapes
3. Modal mass participation factors
4. Modal combination procedure (square root sum of squares, complete quadratic combination, etc.)
5. Governing loads and load combinations
6. Maximum forces (moments and shears)/or stresses where appropriate
7. Maximum displacements
8. For time-history analysis:
   a. Plots of stress (or forces) with time for critical location
   b. Plots of displacements with time
   c. Procedure used to determine effective stresses (or forces) for design
   d. Stress contour plots at points in time when stresses are maximum
9. Stability
   a. Resultant locations (permanent rotations)
   b. Sliding factors of safety (permanent translations)

E. Design Measures Taken to Obtain:
1. Ductility
2. Redundancy
3. Continuous and direct load paths
4. Prevent hammering of adjacent structures or components
5. Prevent loss of support at bridge bearings or other bearing locations
6. Smooth changes in mass or stiffness

F. Results of Embankment Analyses
1. Slope stability
2. Liquefaction potential
3. Settlement potential
4. Defensive design measures

G. Results of Foundation Analyses
1. Liquefaction potential
2. Bearing capacity
3. Settlement and deformation analyses
4. Defensive design measures

H. Verification of Analysis Results
1. Comparison of simplified procedure results with dynamic analysis results
2. Comparison of response spectra with time-history results
3. Comparison of results with those for similar type structures
4. Results of consultant review

I. **Presentation of Seismic Design or Evaluation Results**

    1. Assessment of the project and project features to resist the design earthquake results

    2. Defensive design measures taken to protect project features from the damaging effects of earthquakes

    3. Remedial measures required for existing projects