STATEMENT OF
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U.S. DEPARTMENT OF TRANSPORTATION (DOT)
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Good morning Mr. Chairman and members of the Committee. With me today is Richard Beam, Deputy Director of the Office of Pipeline Safety, and James Cooper, Deputy Chief of Structures Research in the Federal Highway Administration (FHWA). Under my responsibilities as Department representative to the Interagency Committee on Seismic Safety in Construction (ICSSC), and as Chairman of the DOT Seismic Safety Committee, I am very appreciative of the opportunity to appear before you today. I am pleased to note that we have delivered our report to Congress on our assessment of the adequacy of current Federal and State Earthquake Design Standards, as required in House Report 101-301.

The Loma Prieta earthquake was barely several hours old before Secretary Skinner was on his way to the site. In the hours following the tragedy, as President Bush's lead official on coordinating the federal response, he gave this disaster immediate top priority, assuring that everything possible was being done during the emergency. In the weeks following, he continued to give it a great deal of his attention, working with the Congress to assure that emergency relief funding would be forthcoming, (which eventually reached the amount of $1 billion), to help the area rebuild their highways and bridges. In all, the Secretary has made three visits to the affected area, meeting each time with the mayors of San Francisco, Oakland, and the other impacted cities, and coordinating with The Federal Emergency Management Agency (FEMA) and the other agencies to help cut through red-tape.

We in the Department of Transportation are fully aware of the sudden loss potential of major earthquakes. As we have seen in the last few years, earthquakes can strike without warning and

with devastating force, claiming thousands of lives and costing billions of dollars. The time to minimize the loss of life and to reduce interruption of vital transportation functions from earthquakes is before they occur. For this reason, the Department continues to expend considerable effort in seeking measures which will reduce the long-range vulnerability of facilities and structures for which DOT provides financial aid, as well as assure that our own buildings and their occupants are made as secure as possible against such hazards.

Early in the 1970's, motivated by the damage sustained by highway bridges during the 1971 San Fernando, California earthquake, the FHWA and the California Department of Transportation (CALTRANS) began exhaustive studies into the seismic performance of bridges, and began developing specifications to make them more earthquake resistant. Basic earthquake engineering research was sponsored and conducted by the FHWA, CALTRANS, the National Science Foundation (NSF), the National Institute of Standards and Technology (NIST) and the U.S. Geological Survey (USGS). Basic research was completed by 1977. The FHWA itself sponsored approximately $3 million of research on this topic.

In 1977, the FHWA initiated a study entitled "Bridge Seismic Design Guidelines" to: (1) evaluate then current criteria used for seismic design; (2) review recent seismic research findings for potential use in a new specification; (3) develop new and improved seismic design guidelines; and (4) evaluate the impact of the guidelines on construction and cost. The guidelines were completed in 1979 and ultimately adopted by the American Association of State Highway Transportation Officials (AASHTO) as a Guide Specification in 1983. [23 CFR 625.5(b)(5)] <u>All States</u> were thus provided improved criteria for increasing the seismic safety of highway bridges.

Yet, as witnessed by the damage caused by the Loma Prieta earthquake, and undoubtedly future earthquakes, we know that as we extend our knowledge about seismic strengthening, these criteria can be further improved. The principle source of this information is the work conducted under the auspices of the National Earthquake Hazard Reduction Program (NEHRP).

Mr. Chairman, your letter of invitation also asked us to address the vulnerability of pipelines. The pipeline system in the United States includes approximately 450,000 miles of transmission pipelines, of which 295,000 miles are for natural gas and 155,000 miles are for petroleum. Transmission pipelines are constructed and financed entirely by the private sector.

In 1970, safety regulations were promulgated by the Department of Transportation covering the operation and maintenance of transmission pipelines and the design and construction of new pipelines. The design regulation included a requirement that the design of new pipelines must take into account external loads, i.e., earthquakes. A majority of today's pipelines, however, were constructed prior to 1970.

During last October's Loma Prieta earthquake, there was no failure of natural gas or petroleum transmission pipelines in the affected area.

Natural gas distribution systems are more often subject to damage during an earthquake. Cast iron mains or service lines are particularly susceptible to failure because of their brittle nature. The Marina District of San Francisco experienced considerable damage to cast iron pipes. In contrast, the Palo Alto Municipal System, constructed of steel and plastic pipeline, suffered little damage. As a result of replacement programs, cast iron pipe is being slowly replaced in distribution systems through substitution of steel or plastic.

Returning to the discussion of the needs of the overall national transportation system, we note that buildings and structures may be made more secure against earthquake damage through two methods: a) designing-in seismic strengthening before construction, or b) retrofitting. The first of these is usually far more efficient, but still can add 3 to 5% to construction costs for a typical building in a high risk area. The second, retrofit, tends to be very expensive, but in some applications can be cost-effective. In the Bay area, a number of the retrofitted highway structures performed well in resisting earthquake damage. Many lives were saved because CALTRANS had developed a program to identify and prioritize its seismicly vulnerable bridges and had already expended more than $60 million on implementing their retrofit program.

A number of earthquake-prone localities (e.g., California, Alaska) have for years incorporated stringent seismic protective features in their local building codes. It is now becoming recognized, however, that although far less seismicly active than the West, an earthquake in certain areas of the East could be more destructive, because:

(a) the composition of the earth's crust is such that the damaging seismic waves travel for far greater distances, and

(b) many Eastern cities, having not experienced a major earthquake in this century, have not required seismic strengthening in their local building codes.

It must be recognized that since not all geographical areas are equally seismicly active, constant trade-offs must be made within each region, matching the level of hazard anticipated at a given locality against the cost of risk reduction for facilities there. An additional complicating factor in establishing improved seismic safety in new buildings is that there are several major building

codes in accepted use throughout the country, each with different seismic standards. One result is that with the exception of the highway area, DOT-sponsored projects have not been treated consistently regarding measures to protect against seismic vulnerability.

In the Department, we have been seeking means by which proactive work such as that by FHWA could be generalized to all of our constituency groups. By our constituency groups, I include not only our grantees, and the interests they serve, but also those in the private sector, who build and operate transportation facilities, and for whom we have safety regulatory responsibilities. In January, Secretary Skinner instituted the following four initiatives for the Department of Transportation, which although modest, would help us move forward in those areas.

1. Seismic Design Awareness - This effort represents an extensive education program for our constituencies and our grantees to identify specific measures that can reduce vulnerability and describe where they are appropriate. Much research has been done in the last 15 years and the lessons learned from recent earthquakes have been documented. For example, earthquake related highway bridge research conducted by FHWA and CALTRANS has definite application to the design and performance of mass transit and railroad bridges. Building related research conducted by or for NIST and NSF has application to DOT facilities. This existing information is fragmented, however, and we are now in the process of combining it in summary form into a transportation context, applicable to specific modal operations.

Concurrently, we are working on the development of technical sessions on earthquake design measures for transportation facilities in various constituency conferences, including those sponsored by the Transportation Research Board, the

American Public Transit Association, and the American Society of Civil Engineers. These fora provide DOT the opportunity to alert and assist managers and planners in the development of projects, highlighting those safety measures that are available and appropriate, to deal with the consequences of major earthquakes, especially in the eastern part of the United States.

2. Development of Uniform Standards for DOT Programs - A long range Department objective is the establishment of a uniform Department philosophy for seismic design. This will provide the technical underpinnings for both safety regulation and for guidance to our grantees on building standards, specifications, design criteria, and construction practices. These will draw on the quality material prepared by the ICSSC and will in many cases exceed the current local building codes, particularly in certain Eastern cities. These requirements must be judiciously imposed -- overly stringent designs where they never will be needed can be just as wasteful as future losses where they should have been employed.

3. Development of Retrofit Policy - Although most retrofit projects are expensive, there are some cases where low cost improvements to existing buildings and structures operated by DOT constituents would be warranted, (e.g., a $20,000 expenditure can add considerable protection against collapse of a bridge span and thus save lives). Again, fragmented information exists for retrofitting concepts on buildings and transportation structures, but to be of use to our constituencies, existing information must be collated into policy guidance on where to encourage their use. Part of this effort includes evaluating how our present body of knowledge can be augmented with additional research and experimentation to develop more model applications.

4. Assess Our Own Facilities and Functions - The Department is taking an inventory of its own significant buildings and structures to assess their seismic vulnerability. The assessment includes consideration of the number of occupants, the criticality of the functions which they house, their geographic region, and their construction type, to identify those with the highest priority for seismic strengthening. The Federal Aviation Administration has developed a computer program which is being used for the department-wide seismic vulnerability assessments. The identification of the installations of possible concern should not be too costly. Later, the most critical problem installations will have to be evaluated on-site to identify appropriate corrective action.

I would like to conclude on the note that when a major earthquake occurs, transportation systems and services have an importance that goes far beyond their everyday function . If the transportation facilities are able to withstand destructive tremors and continue operations, this will have benefits far beyond the importance of any single building, airport or bridge. The ability of utilities, communications, hospitals, supply depots and key government buildings to respond in the wake of a major earthquake's devastation, to sustain and to assist rescue and relief efforts, and to assist subsequent economic recovery, will depend directly on the resilience we have built into the transportation system.

That concludes my prepared testimony Mr. Chairman, and I would be pleased to answer your questions.