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DEVELOPING A MODEL LIFELINE PROTECTION PROGRAM FOR DOE FACILITIES

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A National Lifeline Standard Development Program is currently being conducted by FEMA and NIST. The Dept. of Energy is following these developments and supplementing them to meet Life-Safety and mission requirements for all DOE facilities as part of the Natural Phenomena Hazards Mitigation Plan. The task will be overseen by a DOE management team with technical guidance provided by a Steering Group of management and operating contractor representatives. The DOE will participate in the federal program by conducting a workshop on lifeline protection issues, developing an overall plan, organizing a Steering Group, and conducting a pilot study at a DOE facility. (Source: R. Murray, Fourth DOE Natural Phenomena Hazards Mitigation Conference)

This article presents guidelines for development of a "Model Lifeline Protection Program" that is consistent with the performance objectives stated in DOE Natural Hazards Mitigation Plan (DOE Order 5480.28) and the site-specific probabilistic hazard design criterion available for many DOE facilities. The Model Lifeline Program is based upon a systems approach for assessing the performance of each lifeline system (utility service) as a complete entity. Each lifeline system would be evaluated as an independent system subject to specific failure modes applicable to that system. The systems approach ensures (a) the continuity of mission-dependent operations and essential plant functions, and (b) adequate damage control measures prior to/and after an NPH event.

IDENTIFICATION OF DEFICIENCIES

The Model Lifeline Protection Program is generated by a series of "Yes/No" questions applicable to each utility service. The questions were developed from real lifeline failure experiences and reflect the performance characteristics of the individual systems. The questions are formulated to identify deficiencies in a generic lifeline system relative to a site-specific NPH hazard. The identified deficiencies should be prioritized and classified into assessment categories for final evaluation and mitigation. The deficiencies should also be correlated with the facility's Pre-Event Preparation Plan and Post-Event Recovery Plan in order to provide a complete account of the needs/requirements of each lifeline system.

EVALUATION

Each facility lifeline system, including all the various system components, should be evaluated for site-specific hazard design criterion per DOE Order 1020-XX, and a PC-2 performance category per DOE Order 1021-XX. Higher PC-values would be applicable only to the lifeline extension between the higher-performance facility and the nearest system control point.

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The Model Lifeline Protection Program should implement the following "Control Plans" for each lifeline system:

- . An Inventory of materials, tools, and equipment necessary to repair a damaged network.
- . A Site Plan identifying the lifeline distribution system and indicating the location of key system control points (shut-off valves or other control mechanisms).
- . A Back-up Operational Plan to provide minimal service in case of failure associated with the primary system.
- . A Plan for Training Service Crews in emergency response and repair activities.
- . A Plan for Loss of Service from a public utility company.

******* Editor note: If space limitations prevent inclusion of the following questionnaire list, delete list and insert the following sentence:**

The Control Plans described above were generated from responses to the list of Y/N questions. The list is too detailed to mention in this article, but is available from the author:

If space allows incorporation of the list, insert the following sentence:

The Control Plans described above were generated from responses to the following list of "Yes/No" questions...and the deficiencies enumerated therein. The questions have been modified for generic determination:

******* End of edit note *******

- . Is emergency power available for critical programmatic operations, treatment facilities, and essential plant support functions?
- . Are portable lights, generators, chlorinators, pumps (...and other equipment...) available to perform emergency repairs on damaged systems?
- . Are radio/wireless devices available for site-wide communication, dispatching, and/or contacting repair crews?
- . Is there an inventory of emergency repair materials and parts for the (_____) lifeline system ?
- . Are facilities and equipment available to sample water quality to assure potability?
- . Has your department conducted an accident vulnerability assessment of the (_____) lifeline system? Are the repair crews trained in detecting damage?
- . Have the Operating and monitoring equipment been checked for proper anchorage?
- . Has your department developed emergency response plans for an NPH event?
- . Has your department developed a method for logging problems and system operations to establish priorities for repair activities?
- . Has your department conducted a cross-training program for service personnel for emergency operations, communication methods, logging operational data, and locating/assigning crews, equipment, and material for emergency repairs?
- . Has your department conducted emergency response exercises for various types of damage postulated to occur as a result of an NPH event?

- . Has your department installed flexible connections between underground service lines and entry into a building?
 - . Has your department provided breakaway or fusible connections and/or safety cables to prevent equipment from being displaced and damaging adjacent equipment?
 - . Does the (_____) lifeline have redundancy in the system? (i.e. are there diversion loops in the system to avoid damaged service lines, inter-connected pressure zones, alternate power supplies, etc)?
 - . Does the (_____) lifeline system have isolation valves at creek-crossings, unstable ground conditions, and other key locations? Are they accessible? Are they located on a site map?
- (Source: EERI "Earthquake Spectra" Journal, Supplement to Volume 6; May 1990; Article entitled "Lifelines"; A.J.Schiff et al).

PERFORMANCE GOALS

In order to meet the DOE-NPH Program goals, the importance of each lifeline system must be directly related to the NPH performance objectives. To accomplish the DOE-NPH Program goals and performance objectives, existing lifeline systems should be up-graded to: (a) ensure life-safety protection issues for federal and contract employee's; (b) limit system damage to a repairable condition; (c) ensure continuous function of essential plant functions and/or mission-dependent operations; and (d) protect the public/environment from exposure to hazardous materials. Accordingly, evaluation and mitigation of deficiencies would concentrate performance requirements on the following issues:

Ensuring performance of "Vulnerable Components" such as gas pressure reducing stations, electrical transformers, water pumping stations (for fire-sprinkler protection service), and liquid fuel emergency supply sources.

Addressing the impact of "Second Order Effects" such as the adverse effect of disrupted electrical service to fire protection pumping stations, the impact of a disruption of natural gas supply to Boiler Plant facilities (used for emergency power sources), fire generated by a disrupted gas service line, back-up systems disabled when adjoining equipment becomes dislodged, etc.

Improving "Operational Efficiency" by developing hazard-specific response plans for each lifeline system, to know the age/condition of all components and equipment in the system, and to develop a reliable supply source for replacement parts. A single department or other organizational framework should have specific responsibility each lifeline system. The response plans should have provisions to immediately replace key personnel who have suffered family tragedies. A separate issue under this category concerns the loss of a Public Utility service. Each Utility Group should have personnel contacts within the utility company to obtain accurate information on the loss of service, estimated duration of down-time, and other essential conditions necessary for technical/administrative decisions.

Developing "Damage Detection Procedures" for immediate identification and repair. This issue would include damage to underground natural gas lines and/or gas

service line connections at a building interface (potential for fire), damage to underground service water lines (especially fire-sprinkler service lines), and/or damage to underground electrical distribution/feeder stations (flooding).

CONCLUSION

The National Lifeline Standard Development Program addresses the life-safety and property damage reduction issues for national/public lifeline systems. The Model Lifeline Program described herein, although preliminary in scope and extent, addresses the same life-safety and property damage reduction issues applicable to DOE facilities. As J.Fitzgerald¹ and R.Barber² noted during the Fourth DOE-NPH Mitigation Conference in Atlanta, the potential for cost-savings on a national scale becomes significant to the DOE. Additionally, the potential for personal injury and property damage could increase in the future if aged structures are not properly mitigated, or new structures designed/sited without adequate consideration for NPH events. Since the underlying purpose of the NPH Mitigation Plan is to prevent naturally occurring events from becoming disasters, each DOE facility needs to provide the creative and effective solutions necessary to achieve the DOE-NPH Program goals.

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