

## **Lifelines Engineering in New Zealand: Moving into the Second Decade**

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### **SUMMARY**

Over the past decade in New Zealand, Lifelines Projects have played an important role in helping individual utility organisations address mitigation and preparedness for regional scale natural hazard events. Lifelines Projects involve the facilitation of a regionally-based collective physical risk management process for natural hazards. Through this process, the vulnerability of many of New Zealand's utility and transportation network operators has been reduced.

This paper describes the New Zealand lifelines engineering methodology, and the mitigation and response preparedness achievements over the past decade. The challenges faced by the utility sector in continuing to reduce its vulnerability to regional scale natural hazard events are also outlined.

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## **1. INTRODUCTION**

Lifelines are those essential services which support the life of communities. These are either *utility services* such as water, wastewater, power, gas and telecommunications, or *transportation networks* involving roading, rail, ports and airports.

Significant developments have occurred in the field of lifelines engineering over the past decade both in New Zealand and internationally. In New Zealand, this period encompassed both the beginnings of lifelines activity and its development into being an established discipline across virtually all regions.

The overall objectives of Lifelines Engineering are:

- (i) to reduce damage levels following a major disaster event; and
- (ii) to reduce the time taken by lifelines services to restore their usual level of service.

## **2. THE NEW ZEALAND LIFELINES ENGINEERING PROCESS**

### ***2.1 Origins and Current Status***

Lifelines engineering in New Zealand began as a separate discipline with the *Lifelines in Earthquakes: Wellington Case Study* project. This project was initiated, produced and largely funded by the Centre for Advanced Engineering, and was completed in 1991 (CAE, 1991). This project has provided the impetus and a point of reference for all subsequent lifelines work in New Zealand.

There are currently 15 Lifelines Projects either planned or underway across New Zealand. This essentially correlates to one Project for each of the country's regions. Once the many positive benefits from the initial projects became apparent, the regional lifelines model and methodology spread rapidly across NZ in the late 1990's.

## 2.2 NZ Approach

The New Zealand Lifelines process is based around the following risk management steps:

- Identifying the *hazards* which could affect each lifelines network
- Compiling common *inventories* of the various utility and transportation networks
- Assessing the *vulnerability* of the lifeline network to those hazards (the *potential damage* to and *consequences* for each network)
- Identifying and implementing practical *mitigation* measures
- Facilitating the preparation of comprehensive *emergency response* plans

This process is based on risk management methodology encapsulated in AS/NZS 4360:1999 (SA & SNZ, 1999), and is described more fully elsewhere (Brunsdon, 2001)

With respect to hazards, the focus of lifelines work in New Zealand is on ***regional scale events*** that are beyond the ability of individual organisations to respond to and control. The responsibility however for taking appropriate mitigation and preparedness steps remains with the individual organisations.

The five key Lifelines steps typically take from 3 to 5 years to work through for each region, and result in a major report. Reports have been completed by Lifelines Projects in the major metropolitan centers of Wellington (CAE, 1991), Christchurch (CAE, 1998), Dunedin (DELP, 1999) and Auckland (ARC, 1999). Projects currently underway in the remaining regions face the challenge of adapting the metropolitan methodologies to suit smaller and more dispersed centres with much less dense and/ or widely spread utility networks.

The Lifelines process is however an ongoing one, reflecting the iterative nature of risk management generally. Communication of the findings, outcomes and recommended mitigation and response preparedness measures to stakeholder groups and the wider community follows the completion of the initial report. This is a progressive and continuous process, often leading to a review of individual asset management plans. A review of mitigation and preparedness progress and achievements across all organisations involved is typically conducted on an annual basis. This important step maintains the momentum and information exchange achieved by the earlier work.

### 2.3 Achievements

There has been a range of physical mitigation undertaken by the various utility sectors over the past decade. While some of this work was or would have been initiated by the respective individual utility asset management plans, the lifelines process has provided a sharper focus and often a greater sense of urgency in the ‘toughening’ of networks.

A sample of generic mitigation projects for each of the key sectors is outlined below:

<b>Water Supply</b>	Seismic upgrading of reservoirs, often with the addition of automatic shutoff valves Creation of medium-term (10 to 20 year) mitigation programmes integrated with Asset Management plans
<b>Electricity</b>	Strengthening or replacement of substation buildings Upgrading of switchyard facilities, including transformer mountings and switchgear support frames
<b>Gas</b>	Relining of old cast iron gas mains in the capital city of Wellington with modern PVC mains operating at higher pressures Improved the ability to isolate gas distribution networks into smaller sectors by the introduction of more valving
<b>Telecommunications</b>	Strengthening of exchange buildings Achieving greater route diversity by developing new cable routes
<b>Transportation</b>	Developed seismic evaluation methodologies for road bridges that take the availability of alternative routes into account Strengthening of vulnerable road and rail bridges

Virtually all utilities have undertaken programmes to brace and tie down control cabinets and computers in control rooms. Some utilities have developed new systems of equipment and spare parts inventories and storage (eg. horizontal storage of critical and brittle spares to minimise damage).

With respect to response preparedness, there has been a growing awareness of the implications of dependence of many utility organisations on their maintenance contractors. Maintenance contracts are now subject to more careful scrutiny to ensure that appropriately experienced repair personnel are available on a stand-by basis and, more importantly, they are available on an exclusive basis rather than being shared with other utility companies. This highlights one of the key thrusts of the new Civil Defence Emergency Management arrangements in New Zealand, which is to place greater emphasis on self-sufficiency by key utility organisations.

### 3. CURRENT AND FUTURE CHALLENGES

Lifeline utilities have undergone considerable transformation over the past decade. The restructuring in most sectors has led to a greater commercial focus, particularly for those with revenue directly at risk. This in turn has led to significant advances in financial risk management. However many of the 'newer' utilities have not given the same level of attention to mitigation and preparedness for longer return period hazard events. The same can also be said for some from the category of utilities that do not have revenue directly at risk.

A major need is the development of a consistent economic framework for justifying investment for mitigation and preparedness for low probability/ high impact natural hazard events. This remains a significant challenge.

There is also a need to recognise at the governance level of many utility organisations that in the absence of 'real' events, specific steps need to be taken to achieve an appropriate level of robustness. This is otherwise known as establishing a defensible position.

#### **4. CONCLUDING OBSERVATIONS**

The response of a utility organisation after a major emergency is heavily influenced by the performance of other utility agencies. The key feature of the Lifelines process is that by working together, utility organisations can identify the common areas of physical vulnerability, and understand the problems faced by those utilities upon which they in turn depend. A clearer set of mitigation priorities results, with benefits also flowing on into the critical response phase operations.

New Zealand's regionally-based approach to lifelines work is considered to be unique internationally. This is due to the close technical co-operation between the various organisations involved which cuts across commercial considerations.

The key to the success of lifelines work in New Zealand lies in its ability to portray the wider view of risk from natural hazards, with particular emphasis on earthquakes given New Zealand's seismic context. Lifelines studies and the analysis of recent international earthquakes have generated a much clearer picture of what the real situation is likely to be following a major natural hazard event. This information is being applied in a range of ways by Civil Defence Emergency Management agencies,

with whom utility organisations have developed stronger working relationships.

Many organisational challenges however remain for New Zealand in creating an integrated response capability within and across the various utility sectors.

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