WORLD FEDERATION OF ENGINEERING ORGANIZATIONS
FÉDÉRATION MONDIALE DES ORGANISATIONS D'INGÉNIEURS

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World Federation of Engineering Organizations
Committee on Engineering and the Environment
UNFCCC – Nairobi Work Program

2009-10 Progress Report on WFEO Action Pledge - "Adaptation of Sustainable Civil Infrastructure to Climate Change Impacts"

Introduction

It is fundamentally clear that climate change represents a potential new risk to the safety of engineered systems and to public safety i around the world. As such, it is incumbent upon engineers to address infrastructure climate change adaptation as part of our primary mandate – protection of the public interest, which includes life, health, property, economic interest and the environment. Climate change results in significant changes in statistical weather patterns resulting in a shifting foundation of fundamental design data. Physical infrastructure systems designed using this increasingly inadequate data are vulnerable to accelerated deterioration, damage and possibly failure, compromising public safety and seriously impacting the public interest.

Background

The World Federation of Engineering Organizations (WFEO) is an international body that is comprised of national engineering organizations, international organizations and individuals from over 90 countries representing more than 15 million engineers. Engineers Canada is a member of the WFEO, representing the Canadian engineering profession. Engineers Canada currently chairs the WFEO Standing Committee on Engineering and the Environment (WFEO-CEE).
In March 2009, the WFEO adopted an action pledge related to the adaptation of infrastructure to the impacts of climate change that was subsequently communicated to the UNFCCC Nairobi Work Program. The pledge was structured as an engineering project with two purposes:

- To develop and implement engineering tools, policies and practices for risk assessment and adaptation of existing and new civil infrastructure to climate change.

- To build knowledge, experience and appropriate techniques to enhance the technical capacity of engineers to adapt civil infrastructure to climate change, particularly within developing and least developed countries.

This progress report covers the period from September 1, 2009 to April 30, 2010.

Infrastructure Climate Risk Protocol

Since 2005, Engineers Canada has been leading a project in Canada to complete a national engineering vulnerability assessment of existing and planned public infrastructure to the impacts of a changing climate. A formalized risk assessment tool, now referred to as the Engineers Canada

Infrastructure Climate Risk Protocol ("the Protocol"), was developed and successfully tested in ten case studies, three of which were completed in the reporting period and are summarized in this report.

The Protocol systematically reviews historical climate information and compares the nature, severity and probability of future climate changes and events with the adaptive capacity of an individual infrastructure as determined by its design, operation and maintenance. It includes an estimate of the severity of climate impacts on the components of the infrastructure (i.e. deterioration, damage or destruction) to enable the identification of higher risk components and the nature of the threat from the climate change impact. This information can be used to make informed engineering judgments on what components require adaptation as well as how to adapt them e.g. design adjustments, changes to operational or maintenance procedures.
The Protocol is being used to assess infrastructures in Canada in four infrastructure categories, including buildings, storm water/wastewater systems, roads and associated structures (e.g. bridges and culverts) and potable water supply and water management systems including coastal structures. This tool is available for use with no financial charge through a license agreement with Engineers Canada.

The first national engineering vulnerability assessment report from Engineers Canada was issued in April 2008 and includes appendices with the individual reports from the first seven case studies with an initial assessment of the collective results. The report is available at the website www.pievc.ca.

Recent Canadian Case Studies

Three new case studies were completed in the reporting period including:

1. Metro Vancouver – Fraser Sewerage area stormwater and wastewater collection and treatment system
2. Toronto and Region Conservation Authority – two water control and retention dams
3. British Columbia Ministry of Transportation and Infrastructure – Coquihalla Highway

These studies advanced the analysis and treatment of climate data and projections using the most up to-date climate scenarios and the analysis of historical climate data to develop probabilities of climate parameters exceeding defined thresholds for the infrastructure.

Some findings from each of the three case studies include:

- The Metro Vancouver Fraser Sewerage Area is primarily a separated sewer system which reduces the impact of severe rainfall events on the collection and treatment system with few, if any overflows anticipated. The dyke system that protects the stormwater and sewage treatment plant has some vulnerability to the combination of high river levels and storm surge, which merits a review of its capability to handle these future possible events.
- For the two dams operated by the Toronto and Region Conservation Authority, it was concluded that both structures are robust enough to be able to withstand the typical climate events that are, and could be experienced in the Toronto area now and in the future.
- There were a number of interactions where the probability of occurrence of the extreme climate event was low but the severity of impact is very high leading to a recommendation to incorporate these scenarios into future operations and maintenance reviews and future upgrades and rehabilitation of the infrastructure.

- The Coquihalla Highway study revealed that the highway is generally resilient to climate change with the exception of drainage infrastructure response to intense rainfall events arising from a meteorological phenomena known as the Pineapple Express. Specifically:
  - Water ponding on roadway surfaces could cause safety hazard for vehicle traffic (i.e. hydroplaning, etc.);
  - Water ponding on roadway surfaces could impede emergency response;
  - Maintenance effects could include increased erosion; and
  - Environmental effects of increased erosion include carrying sediments and contaminants to watercourses.

The final reports from these case studies will be available on the website by June 2010. All include executive summaries.

New Canadian Case Studies Underway

Several new case studies are underway and will be completed over the next year. The owner and category of infrastructure for these are as follows:

1. Government of Northwest Territories – Rehabilitation of Highway 3 infrastructure
2. District of Shelburne, Nova Scotia – Design of a new sewage treatment plant
3. Ontario Realty Corporation – Three public buildings with different uses in SW Ontario
4. Town of Prescott Ontario – Stormwater management and treatment system
5. City of Toronto, Ontario – Assessment of selected road culvert systems
6. City of Calgary, Alberta – Potable water collection, treatment and distribution system
7. City of Castlegar, BC - Stormwater management and treatment system

The owners of these infrastructures come from different geographic regions in Canada, include small communities and large cities with populations from a few thousand to millions of people and include provincial and municipal levels of government

Other case studies are in negotiation and will be noted in the next progress report.

Training Workshops

In the fall of 2009, Engineers Canada developed a one-day workshop on the principles and applications of infrastructure climate risk assessment. The workshop is oriented towards target audiences that include engineers, planners and managers of civil infrastructure.
The workshop includes the theory and principles of risk assessment in the context of climate change. It also introduces the Protocol and its various steps. The workshop includes hands-on exercises where participants in small groups define climate parameters and infrastructure components and climate risks. It includes presentations on case studies that demonstrate the application of the Protocol in the four infrastructure categories.

From November 2009 to April 2010 this workshop was delivered in five locations across Canada to nearly 200 participants. More workshops are scheduled in the next few months.

The first international version of the workshop was delivered through the World Federation of Engineering Organizations Committee on Engineering and the Environment to 25 participants from 7 Latin American and South American countries at the international conference “Thinking the Americas”, on March 24, 2010 in Recife, Brazil. The countries included Argentina, Belize, Brazil, Costa Rica, Honduras, Mexico, and Panama. Following the workshop, several participants

requested this workshop be held in their country and, subject to available funding, negotiations are underway to confirm dates and locations. The World Federation of Engineering Organizations Committee on Engineering and the Environment will offer this workshop to other World Federation of Engineering Organizations countries in the coming months on a cost recovery basis.

Risk assessment of civil infrastructure to climate change requires a multi-disciplinary approach. Another important objective in the training is to build capacity of other supporting disciplines and stakeholders including meteorologists, climate change scientists, engineering and technology professionals as well as management, operations and maintenance personnel administering and operating the infrastructure. As a result these professionals and other personnel are invited to these workshops.

UNFCCC Side Events

A two hour parallel event on climate change mitigation and adaptation of infrastructure was held at the UNFCCC COP-15 meeting in Copenhagen Denmark. The event was organized by the Danish Society of Engineers in partnership with the World Federation of Engineering Organizations Committee on Engineering and the Environment..
A two hour side event on infrastructure climate risk assessment is scheduled at the UNFCCC Climate Talks in Bonn, Germany on June 11, 2010.

Emerging Opportunities and Challenges

The Protocol has been successfully applied in Canada and the work continues to complete additional case studies to build a knowledge base in each of the four infrastructure areas. The Protocol will be further clarified to reflect the results from this round of case studies with an intention to formally publish it in the fall of 2011.

The knowledge base resulting from the case studies in Canada will be assessed by Canadian engineers and scientific experts to develop recommendations for adjustments to national and regional infrastructure design and operation/maintenance codes, standards and engineering practices to account for climate change impacts. These recommendations will be completed by the fall of 2011.

The Protocol is the intellectual property of Engineers Canada. By virtue of its membership in WFEO, there is an opportunity to apply the same methodology for infrastructures located in newly developed and developing countries. The capacity to perform these assessments and to take remedial action does not generally exist; therefore these case studies take the form of knowledge development and capacity building to enable countries to undertake their own assessments in the future.

The long-term goal is to successfully transfer the application of the protocol to newly-developed and developing countries to provide a relatively low cost assessment tool to plan cost-effective adaptation of existing and planned infrastructure to the impacts of future climate change. Adaptation is most effective when it is implemented locally in response to local needs and capabilities. For newly developed and developing countries there must also be a capacity at the country level given the scarcity of human and financial resources.

There is an opportunity to develop this capacity and to identify and address infrastructure vulnerabilities through a case study approach that matches Canadian engineers with infrastructure engineers, planners and decision-makers in these countries. The challenge is to identify and secure funding for these projects. Engineers Canada, through the WFEO-CEE has developed a

concept proposal to conduct infrastructure climate risk assessment through a knowledge development and capacity building approach that would be applied to newly developed and developing countries.

Our first proposed international case study involves assessing a sewage treatment system in Costa Rica in cooperation with their Colegio of engineers. A knowledge development and capacity building case study proposal has been submitted for funding support.

Costa Rica is a member of the WFEO and the WFEO-CEE. The Colegio also chairs and maintains a leadership role in Unión Panamericana de Asociaciones de Ingeniería (UPADI), a Pan-American multi-lateral organization of national engineering organizations within the Caribbean, Latin America and South American regions. Success in Costa Rica will translate into access to developing countries and, by working in close partnership with the Colegio, we should improve the chances for successful capacity building in other Pan American countries.

This case study would be followed by similar projects in other developing countries with the long-term goal to standardize the Protocol as an accepted engineering and planning practice for infrastructure climate change vulnerability assessment worldwide. There are tremendous opportunities for international, regional and local cooperation to build local awareness and expertise to adapt infrastructure to climate change impacts in a cost-effective manner that best addresses the engineering vulnerabilities and risks.