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Safety during River Ice Data Collection

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Traditionally river ice scientists and engineers relied on experience for safe operations on river ice covers while collecting much needed data to advance the science of river ice engineering. In the fall of 2001, BC Hydro planned to expand their data collection program to include workers to be on the ice on the Peace River, AB. This raised safety concerns. After some inquiries, suitable safety training was found to be available from Rescue Canada Resource Group Inc. In the past, this company had provided training to groups in the business of rescuing, such as fire departments as well as some government departments. Since, in BC Hydro's case, the work would be conducted in semi-remote locations, a training program had to be customized so that the employees could manage the risk on the river ice cover on their own. After assessing what fieldwork BC Hydro would need to conduct, the Rescue Canada Resource Group designed a 2-day course called "Ice Safety Operations" that consisted of classroom as well as training on river ice and in frazil filled moving water.

The Rescue Canada Ice Safety Operations Certification Course was based on the application of proven "Swiftwater" principles to the ice environment, both on lake and on moving water. This allowed risk assessment skills, and the application of multi-purpose equipment and techniques that are common in swift water, rope and boat to be transferred to the ice environment. The activities were based on specific tasks the course participants would be responsible for performing and specific equipment for a job. The focus was on decision-making as it related to occupational safety, hazard awareness and avoidance, self-rescue, rescue of teammates, job/task efficiency and effectiveness.

1. Introduction

River ice engineers and scientists have been venturing out onto river ice to gather scientific data for decades. This poses some risk to these individuals, as there is a potential to fall through the ice that can lead to hypothermia. If the individual is not rescued and protected from the elements in sufficient time the results can be fatal. Worse still is the potential to be swept under the ice cover by river currents that can lead to a certain fatality.

These dangers have been managed or addressed by various organizations involved in this type of work by several approaches. These include, learning from experience, written procedures, work avoidance, and formal training.

2. Learning from experience and the experience of others

Until recently, this has been the main method of learning safe practices on river ice. Many research engineers and scientists recall their first time out on the river ice with a mentor. The more experienced individual would teach them about where to go and where not to (hazard avoidance), what types and thicknesses of ice were safe and how to test the ice with a chisel before stepping on it. This type of training is very valuable if the mentor is sufficiently experienced. However, due to the lack of formal procedures, it is susceptible to errors in judgment and the risk of not acquiring a complete skill set. The training rarely specifies what to do if one gets into trouble and concentrates mostly on hazard assessment and avoidance.

Figure 1. Class receives instruction on setting anchor points from Larry Obst, Rescue Canada instructor (left). Photo Frank Weber.

3. Written procedures

Often organizations reinforce the “learn from experience” process by developing formal guidelines. These guidelines however are specific from organization to organization and no national or international guidelines exist. The procedures are often very specific to a certain location or a certain ice type and it may be difficult to come up with a set of procedures that offers the same factor of safety for everyone. Again written procedures often do not outline what to do when someone falls through the ice but concentrate on hazard avoidance.

4. Work avoidance

Work avoidance is often precipitated by unfortunate incidents. Often an incident involving someone falling through the ice is followed by a cessation of all field programs that require individuals to be out on the river in the winter. It is a reaction that is often over conservative as many rivers are very safe in mid and late winter when the ice can be of substantial thickness. Scientific programs can suffer significant set backs under in this type of scenario.

5. Formal Training

Formal training on what to do if one falls through the ice and on hazard avoidance has not been available until recently and is the subject to this paper. Rescue Canada Resource Group Inc. is one firm that offers this type of training. Since it is a relatively new area, it is a program that is constantly evolving. It is hoped that participation at the 12th Workshop on River Ice will lead to discussion and future partnerships that will improve the program further.

Figure 2. Frank Weber hauls Dan Nixon out of frigid water using ice anchors and a pulley system, Nechako River, Prince George, BC.

6. Ice safety operations training
It is not the aim of the paper to serve as a training document, therefore, detailed information will not be discussed but rather the various topic areas of the ice safety operations course will be presented.

The basic philosophy of rescue instruction was covered first, followed by a dozen key items to keep in mind if faced with an ice related rescue situation. These included:

1. wear your safety equipment if dangers warrant it
2. rescue prioritization (self, team mates, victim, equipment)
3. team work is critical
4. always keep it simple
5. never count on a victim to help in their own rescue
6. medical conditions are a serious consideration in an ice rescue
7. never lose a victim once contact is made
8. always have a back-up plan
9. never tie into a rope system without personal release capability
10. never put your feet down if you are swept away
11. always be pro-active and recognize and avoid danger
12. never stand in the bite of a rope

Figure 3. Frank Weber being hauled out with pulley system.

There was a section on ice characteristics, ice formation and ice strength followed by a module about specialized equipment. The most important piece of equipment is a rescue floatation vest with designed anchor points to attach rescue equipment and roping. It is also a must that the vest has personal release system capability as in some situations it may be necessary to quickly disconnect from a rope system. Knots, anchors, and mechanical advantage pulley systems were practiced in the classroom and outdoors.

There was section on additional aspects of safety, which included travelling on ice, victim profiles, and self-rescue techniques. Additional materials illustrating the importance of communicating with the victim and assessing their mental and physical condition during the rescue were presented.

Various types of rescues were covered and included shore based techniques, throwing rescues, ladder lever rescue, and the tag line rescue. Medical issues such as hypothermia, cold water drowning, cold water near drowning, shock, and cold injuries were covered.

Figure 4. Dan Nixon awaits rescue by his teammates.

7. BC Hydro's experience with ice safety operations training

BC Hydro owns and operates two hydroelectric facilities on the Peace River in Northern British Columbia, the Bennett and Peace Canyon Dams. The Peace River in Alberta sometimes experiences flooding due to ice jams and the upstream hydroelectric facilities have to be managed in such a way to mitigate this problem while at the same time attempt to optimize hydroelectric generation. Field data on ice thickness, strength and ice type are needed to quantify the many physical and complicated processes. Therefore, in the winter 2001-2002, BC Hydro commenced a field program on the Peace River in Alberta. It had not participated directly in "on ice" measurements for many years and safety issues arose. After some inquiries, suitable safety training was found to be available from Rescue Canada Resource Group Inc. In the past, this company had provided training to groups in the business of rescuing, such as fire departments. Since in BC Hydro's case the work would be conducted in semi-remote locations a training program had to be customized so that the employees could manage the risk on the river ice cover on their own. After Rescue Canada examined BC Hydro field program, the company designed a 2-day course called "Ice Safety Operations" that consisted of classroom as well as training on river ice.

Figure 5. Frank Weber practices self-rescue using ice awls.

The anticipated field program plan consisted of drilling holes in the ice to measure thickness and the cutting of larger holes to determine water-ice interface roughness. Block's of ice would be chain-sawed and lifted out of the hole and flipped over so the under ice surface could be examined. Depending on the ice conditions, this work would be done soon after freeze-up as possible and then again later in the season in order measure differences as the ice matured over the winter. The dangers identified from this field program were the possibility of falling through a thin crust as well as through the chain-sawed holes. It was assumed that the under ice water velocities were substantial and posed a risk of pulling a worker under the ice. These risks were identified to the course instructor and the training was customized for this type of work.

On Dec 17-18, 2001 BC Hydro employees attended an Ice Safety Operations course in Prince George, BC held by Rescue Canada Resource Group Inc. (Figures 1-8). The practical portion of the course was held on the nearby Nechako River (Figures 1 to 8). Conditions on the Nechako River consisted of competent 5 to 10 metres of border ice with frazil shush and small frazil pans (<1.5 m) in the river. The water velocities were between 0.5 to 1 m/s. Dry suits were worn.

Figure 6. Martin Jasek senses the reassuring tug on his harness as his teammates prepare to rescue you him. Photo by Frank Weber.

Methods of constructing anchor points on shore and on the border ice using ice screws were taught. The participants were able to practice self-rescue techniques including the use of ice awls, prusik loops as well as without any specialized equipment. The students could experiment with various techniques to decide what worked and what didn't. A particularly effective method of getting up onto the border ice from the moving flow without using specialized equipment was also practiced. One would swim as quickly downstream at a 45-degree angle to the current and the border ice. As one would arrive at the edge of the ice with good speed one would leap onto it like a seal. This method was very effective and would not be immediately obvious without experiencing it. Team rescue techniques were also practiced and involved the setting up of pulley systems to obtain a mechanical advantage over the drag of a strong current. In practice, these pulley systems would have to be set up prior to workers venturing out onto the ice.

The course provided a unique opportunity for engineers and scientists interested in river ice to experience them first-hand. What better way then to submerse yourself among the frazil pans, feeling them gently bumping against you as your teammates hauled you out of the water. Frazil deposits under the border ice could be prodded with ones legs and were surprisingly dense and firm. One could poke ones legs into the frazil and provide enough anchoring force to prevent the current from carrying one downstream.

Figure 7. Dan Nixon practices self-rescue using ice awls. Photo by Frank Weber.

8. BC Hydro's experience with ice safety operations on the Peace River

In January 2002 BC Hydro personnel conducted fieldwork on the Peace River. The task was to measure ice thickness and under ice roughness for ground truthing RADARSAT satellite images. The goal of the project was to determine if changes in the ice cover could be detected through the winter by RADARSAT. Since most of the change occurs soon after ice cover formation, it was important to do the sampling as soon as possible after the ice cover was in place. The ice front had traveled upstream of the reach of interest late on January 21 and two days later the ice was assessed for safety. The weather was about –30 ^{o}C with high windchills allowing the ice to thicken quickly.

Ice screws were set into the competent border ice that was more than 0.5 m thick. A worker wearing a swiftwater PFD was belayed out onto the ice using the same methods as learned in the Ice Safety Operations course a month earlier. The BC Hydro employees also used the same type of equipment that they had trained with. Firm strikes with the ice chisel indicated that the ice was competent. A hole made with the chisel indicated a safe thickness with at least a meter of frazil slush underneath. The actual value is not reported here since a safe thickness can vary between rivers and situations. The fact that the discharge was anticipated to be relatively constant was considered in this assessment. Larger river fluctuations require a thicker cover for stability.

Figure 8. Safe ice sampling on the Nechako River by Martin Jasek. Photo by Frank Weber.

After the ice was determined to be reasonably safe, a second worker also wearing a PFD attached to the border ice went out and the two workers laid out a grid where the sampling was going to take place. A third worker remained on the border ice as a precaution. Laying out the grid while being attached to ropes did create some problems as the ice was very rough and the ropes would get caught as the grid was being laid out. The ice was found to be consistent and competent throughout the grid area and eventually the ropes could be disconnected from the PFDs. The work continued for two days without incident. It was estimated that the safety precautions doubled the time from 1.5 hours to 3 hours of laying out the grid. It was reassuring however to have the equipment and training to be on the ice that was only about 2 days old.

As 20 cm diameter holes were drilled into the ice to measure thickness, it was found that a metre or two of slush was consistent throughout the area. This slush provided extra safety by protecting anyone falling through from being dragged under by high velocities. Thus when it came to cutting larger holes in the ice and extracting the blocks, anchoring the workers to prevent someone from falling into the holes became unnecessary. The holes would fill up with slush keeping high velocities at least 2 metres below the surface.

9. Conclusions

Collecting river ice field data can be a hazardous activity but the proper training and equipment can minimize these risks. Companies such as Rescue Canada Resource Group Inc. specializing in rescue techniques can customize procedures to match the tasks of the field program. This type of training is relatively new and is in the process of evolving.

Acknowledgments

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Reference

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