

Ministry of Public Safety and Solicitor
General

Case No.: 2010-0269-0002

CORONER'S REPORT
INTO THE DEATH OF

KUMARITASHVILI

SURNAME

NODAR

GIVEN NAMES

OF

BAKURIANI, GEORGIA

I, Tom Pawlowski, a Coroner in the Province of British Columbia, have investigated the death of the above named, which was reported to me on the 12th day of February, 2010, and as a result of such investigation have determined the following facts and circumstances:

Gender: ☒ MALE ☐ FEMALE

Age: 21 YEARS

Death Premise: WHISTLER SLIDING CENTRE

Place/Municipality of Death: WHISTLER, BRITISH COLUMBIA

Date of Death: FEBRUARY 12, 2010

Municipality of Illness/Injury: WHISTLER, BRITISH COLUMBIA

Time of Death: 1050 HOURS

MEDICAL CAUSE OF DEATH

(1) Immediate Cause of Death: a) Multiple Blunt Force Injuries

DUE TO OR AS A CONSEQUENCE OF

Antecedent Cause if any: b) Collision with Fixed Structures

DUE TO OR AS A CONSEQUENCE OF

Giving rise to the Immediate cause (a) above, stating underlying cause last: c) Luge Incident

(2) Other Significant Conditions Contributing to Death:

BY WHAT MEANS Luge athlete in collision at an artificial luge track

CLASSIFICATION OF DEATH

☒ ACCIDENTAL ☐ HOMICIDE ☐ NATURAL ☐ SUICIDE ☐ UNDETERMINED

Date Signed: SEPTEMBER 16, 2010

Tom Pawlowski, Coroner
Province of British Columbia

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**CORONER'S REPORT**
INTO THE DEATH OF**KUMARITASHVILI**

SURNAME

NODAR

GIVEN NAMES

The Coroners Service of British Columbia is responsible for the investigation of all unnatural, sudden and unexpected, unexplained or unattended deaths in the province. The Coroner's Report is the official record of death that sets out the Coroner's determination as to the identity of the deceased and the circumstances of death, including how, when, where and by what means the person died. The Coroners Service is a fact-finding, not a fault-finding agency, and a Coroner must not make any finding of legal responsibility or express any conclusion of law. Where appropriate and feasible, the Coroner may put forward recommendations aimed at improving public safety. Coroner's recommendations may be directed to public agencies or private entities alike.

SUMMARY OF EVENTS

On February 12, 2010, at 1050 hours, while descending an artificial luge track in Whistler, British Columbia, Nodar Kumaritashvili collided with an ice wall and was ejected to the outside of the track, where he struck a metal post. Mr. Kumaritashvili sustained injuries that proved immediately fatal. Resuscitative measures were attempted, as per established emergency medical protocols, and Mr. Kumaritashvili was transported, pulseless, to the emergency medical clinic at the Olympic Village in Whistler. Medical intervention efforts were discontinued at 1149 hours.

POST MORTEM/TOXICOLOGY EXAMINATION

The autopsy revealed extensive blunt force injuries to the head and torso. The most significant of those was the trauma to the head, which caused immediate death.

The forensic pathologist's report attempted to examine the relationship between the individual injuries and the three major stages of the collision: the initial impact with the inner wall (slider's right) of the track, multiple impacts with the wooden barrier forming part of the outside wall (slider's left) of the track, and impact with the metal post outside of the track. While it may not be possible to conclusively attribute all of the specific injuries to the individual stages of the collision, the video footage of the incident does provide strong indication as to the most likely associations involving the most serious trauma.

There is no evidence that any serious injuries resulted from the initial impact against the inside wall of the track. Injuries were sustained, however, in the subsequent collisions against the low wooden barrier. The most severe point of impact was the collision against the metal post that occurred outside of the track and resulted in an abrupt deceleration, causing the traumatic head injuries.

The toxicological analysis documented no foreign substances.

INVESTIGATIVE FINDINGS

Mr. Kumaritashvili was a member of the Georgian luge team, who travelled to Whistler to participate in the 2010 Olympic Winter Games. Mr. Kumaritashvili qualified for his participation in the Olympics according to the criteria

41



CORONER'S REPORT

INTO THE DEATH OF

KUMARITASHVILI

SURNAME

NODAR

GIVEN NAMES

established by the International Luge Federation (FIL, Fédération Internationale de Luge de Course). As part of the qualification process, an athlete had to have raced in a minimum of five World Cup races, over a period of two seasons preceding the Olympics, earning a minimum of five points in total. The top finisher in a World Cup race is awarded 100 points and all successive finishers earn points on a diminishing scale; with all competitors who finish 40th and lower, earning one point per race. Mr. Kumaritashvili satisfied the requirements by racing at four World Cup events during the 2008-2009 season, earning a total of four points, and placing 55th overall in World Cup standings, in a field of 63 ranked athletes. During the 2009-2010 season, Mr. Kumaritashvili raced at five World Cup events earning a total of 17 points, and placing 44th overall in World Cup standings, out of 70 athletes.

Mr. Kumaritashvili trained for the first time at the Whistler track in November 2009, during the International Training Week. As part of this training, he followed the prescribed routine of initially sliding from lower starts and eventually progressing higher up the track, thus adding speed and difficulty. As part of this progression, Mr. Kumaritashvili took three runs from the lowest, or Novice Start; two runs from the Junior Start; one run from the Lower Women's Start; three runs from the Women's Start; eleven runs from the Men's Start.

Mr. Kumaritashvili did not attend the first International Training Week held at Whistler in November 2008, or the World Cup that was held there in February 2009 and served as the Olympic Test Event. Participation in these events was not mandatory for Olympic competitors. Access to a luge track for training purposes before FIL sanctioned competitions is subject to rules established by the International Luge Federation. FIL Technical Delegates have informed this investigation that there was full compliance on the part of the organizers, with the official rules governing access to the Whistler track for training purposes.

The fatal incident happened during the final scheduled training session the day before competition was to begin. It was the second practice run of the day and Mr. Kumaritashvili's sixth run since training commenced on February 10th. It was estimated that Mr. Kumaritashvili attained the top speed of approximately 144.3 km/h during this final run. Previously, he attained the speed of 124.3 km/h, on his first run originating from the Women's Start; did not finish the second run, from the Men's start; reached 141.5 km/h on the 3rd run; 143.3 km/h on the 4th run and 140.8 km/h on the 5th run. Mr. Kumaritashvili met the final qualifying step for the Olympic competition by finishing within 7% of the fastest finish time in his group. He accomplished this on the third training run: he finished the run in 49.466 seconds, while the top finisher in his training group completed it in 47.040 seconds. The top speed reached by a luger during these training sessions was 153.0 km/h.

According to the technical experts at the International Luge Federation, Mr. Kumaritashvili appeared to have had a routine run until the exit of the penultimate, 15th curve. At that point, Mr. Kumaritashvili experienced a late exit out of the curve, causing his trajectory to deviate from the optimal line for entering curve 16.

The trajectory followed by Mr. Kumaritashvili subjected him to powerful physical forces and their physiological effects on the body, causing loss of control of the sled, which first shot up towards the roof above the curve and subsequently descended abruptly towards the opposite, inside wall of the track. The collision with the inner wall caused the sled's right runner to ride-up onto the ice wall, causing Mr. Kumaritashvili and his sled to be launched into the air. While airborne and separated from the sled, Mr. Kumaritashvili's body became rotated and he travelled, facing backwards, a distance of several metres, diagonally, across the track. Mr. Kumaritashvili struck the top of a low wooden barrier forming part of the outside wall of the track, with his lower torso and left arm. He then slid across the top of the barrier to the outside of the track, where once again, he impacted with his lower torso, this time against the outside of the flared-out barrier. That

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**CORONER'S REPORT**
INTO THE DEATH OF**KUMARITASHVILI**

SURNAME

NODAR

GIVEN NAMES

impact deflected him towards one of the metal posts supporting the roof above the track. He impacted against the post with his upper back and the back of the head, coming to an abrupt stop at the base of the post. The sled, undamaged, continued to travel inside and along the outrun of the track. Scrape marks and gouges in the ice surface that were subsequently attributed by a police collision analyst to the collision with the inside wall, were located approximately 34.94 metres up track from the metal post that caused the final deceleration.

Technical experts from the International Luge Federation examined Mr. Kumaritashvili's sled concluding that it met all the standards required by that organization's regulations. FIL Technical Delegates also carried out an inspection of the track, not finding any deficiencies in the ice surface or ice profiles. Prior to the incident, inspections of the ice profiles had been carried out on a daily basis by a Technical Delegate who subsequently informed this investigation of his approval of the condition of the ice and quality of ice maintenance.

Examinations of the track and of the sled were also carried out, on behalf of the coroner, by the Royal Canadian Mounted Police (RCMP), who secured the scene immediately after the incident and controlled access to the site until it was released to the venue management following an examination and measurement by collision analysts. The RCMP inspection and documentation of the condition of the sled was conducted with the assistance of a luge expert who confirmed that the set-up of the sled, including the angles of the runners and steel edges, was "safe and conservative". Although the sled was deemed to be in conformance with the existing standards, a report released by the FIL noted the previously unseen behaviour of the sled, which did not fracture in the high impact collision with the ice wall. This characteristic of the sled was a result of the highly resilient materials used in the manufacturing process. It was not apparent to this investigation whether different behaviour of the sled, such as its destruction upon the initial impact, would have resulted in a more positive outcome.

Prior to resumption of training, the race management team ordered an increase in the height of the wooden wall along the section where Mr. Kumaritashvili left the track. Additional protective walls were also added in the outrun of the track and padding was placed on metal posts next to the outrun. The ice profile between the base of the track and the sidewalls of the outrun, where the sled rode onto the wall, was modified resulting in a squared transition between the two surfaces. When the luge competition eventually commenced, men's races were held from a lower, Women's Start, while the women and doubles raced from an even lower Junior Start. Racing from the lower starts resulted in a reduction in speeds, of approximately 10 kilometres per hour. Bobsleigh and skeleton races were held from their normal starting positions.

Following Mr. Kumaritashvili's fatal incident, questions arose regarding athlete safety at the Whistler track and more specifically, the design of the track and the unprecedented high speeds attained at this venue, such as the record speed of 153.98 km/h.

Olympic luge competitions take place on artificial tracks that are built specifically for the sport, with a design that utilizes banked curves and walled straightaways. Most artificial tracks incorporate a refrigeration system to ensure a longer season and consistent ice conditions. Artificial tracks differ from natural luge tracks that utilize existing mountain roads and trails, and cannot incorporate artificially banked curves or refrigeration.

Similar in general concept to other artificial sliding tracks, the Whistler track can be described as an iced chute that winds its way down the mountain in a series of 16 banked curves. It is 1700 metres in total length and designed for a competition length of 1379 metres in men's luge, and 1450 metres for bobsleigh and skeleton. It features the highest vertical drop of all the existing tracks, amounting to 152.2 metres from the highest to the lowest point along the men's luge course. Built

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Ministry of Public Safety and Solicitor
General

Case No.: 2010-0269-0002

**CORONER'S REPORT**
INTO THE DEATH OF**KUMARITASHVILI**

SURNAME

NODAR

GIVEN NAMES

of concrete, the running surface of the track is covered with a layer of ice, measuring a few centimeters in thickness. The track is artificially refrigerated with the use of an ammonia coolant that is distributed through pipes embedded in the concrete structure of the track. The ice is vulnerable to temperature and humidity fluctuations and must be vigilantly maintained through the manual work of the track crew who shape and smooth the ice profiles, under the direction of the Ice Master. Consistent ice conditions are required to ensure a fair playing field and more importantly, to ensure the safety of athletes. To that effect, sections of the track are protected from the sun, snow or rain with shades that can be pulled up or down by trackside workers. Whenever possible, the shades are kept in the open position, which favours the spectators and broadcasters, but may be pulled down on orders from the control tower when the ice needs to be protected. The track is located within a complex that also features support infrastructure such as the race start and finish buildings, control tower, track administration buildings and a refrigeration plant.

The Whistler Sliding Centre was purpose-built for the 2010 Olympic Winter Games, and the development of the facility paralleled some of the other processes involved in the planning and staging of this sporting event. In December 1998 the Canadian Olympic Committee endorsed Vancouver as the city that would represent Canada's bid for the Olympics. Vancouver 2010 Bid Corporation was established for the purpose of developing a delivery plan for the Games that was to be submitted to the International Olympic Committee (IOC). Known as the Bid-Book, the proposal identified locations of potential competition venues and outlined associated costs and construction schedules. The Resort Municipality of Whistler was listed as the location of some of the events and venues, including the Whistler Sliding Centre, as the proposed site of bobsleigh, skeleton and luge competitions.

The Bid Corporation previously considered other locations, including sites on Vancouver's North Shore Mountains. These alternate sites were eliminated from consideration early on, as they did not offer the requisite terrain, had a less suitable climate, and were not considered ideal from the post-Games legacy perspective as viable locations for venues that could be used for sport development in the future, while remaining fiscally sustainable. Whistler was identified as the ideal locale since the resort town attracted large numbers of tourists traveling to this destination to participate in winter sports. While having elite training and competitions as the core purpose, sliding centres rely on tourist visits for revenues needed to sustain their operations. The particular site selected for the Whistler Sliding Centre offered a relatively steep profile and a compact footprint, but it met the criteria of the Fédération Internationale de Bobsleigh et de Tobogganing (FIBT) and the Fédération Internationale de Luge de Course (FIL), the two International Federations (IFs) that govern the sports of bobsleigh and skeleton (FIBT) and luge (FIL), respectively. The two federations became involved with the project at the bid phase and provided their approval of the selected site. The site was also considered suitable by the engineering firm that was eventually retained to produce the track design.

The earliest drawing of the Whistler track's centreline superimposed on a map of Blackcomb Mountain was generated by the staff of the Vancouver 2010 Bid Corporation, following the general lay of the contour lines. But it was the work of the joint Track Construction Commission of the FIBT and the FIL, following its visit to the site, which resulted in the first proper rendering of the track centreline. An early conceptual layout for the track appeared in a schematic contained in the Candidate City Bid-Book; however, all these versions of the centreline were only preliminary and would subsequently undergo significant revisions dictated by the terrain characteristics that were revealed through more precise land surveys, by geotechnical and construction considerations, and by FIL and FIBT requirements and results of run dynamics calculations.

In July 2003 the International Olympic Committee (IOC) selected Vancouver-Whistler as the host cities for the 2010 Games, signaling the official start of the planning, design and construction phases of the Whistler track. The Vancouver

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CORONER'S REPORT
INTO THE DEATH OF

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SURNAME

NODAR

GIVEN NAMES

Organizing Committee for the 2010 Olympic and Paralympic Winter Games (VANOC) was established in September 2003 for the purpose of planning, organizing, funding and hosting of the 2010 Games, including the construction and operation of the Whistler Sliding Centre.

Sliding tracks around the world need to be officially homologated, or certified, in order to host competitions and training sanctioned by the International Federations. The two Federations establish rules for their own competitions, equipment and athlete qualifications. In the relatively small field of sliding sports, the two Federations are also repositories of expertise in the areas of track construction and ice preparation. The tracks are homologated independently by each of the two Federations, but most are sanctioned for use by both entities. A track that fails to meet safety or performance criteria of a given Federation would not be able to host international competitions for that sport, but could still be the site of non-sanctioned events and utilized by casual users, clubs, school groups or tourists, who would generally slide from lower start positions, not attaining the same speeds or degrees of difficulty as competitive athletes.

Because the disciplines of luge, bobsleigh and skeleton, all vary in terms of equipment and execution, different track design characteristics may favour the individual disciplines differently. Consequently, a track that is designed to accommodate all three sliding sports may represent elements of compromise. It is a function of the two Federations to ensure that the needs of their specific sports are met. Consequently, the two International Federations maintained their involvement with the Whistler track by dispensing expert advice and ensuring conformity with the requirements of the different sliding sports. This collaboration, which started during the bid phase, continued during the design and construction stages.

In November 2003 a meeting outlining the objectives of the track design took place in Whistler, involving representatives from the Vancouver 2010 Organizing Committee and the FIBT. Minutes from the meeting documented that the goal was to "develop a difficult track that will make a name for itself on both the FIBT and FIL World Cup Tours, i.e. there is more respect for a win on the Whistler track". The overall objectives were considered in the context of the facilities already in existence on the North American continent: of the three existing tracks at the time, Lake Placid was considered a technically challenging track, but Calgary was considered an easy track, while the Salt Lake City track was deemed challenging, but due to its short length, it was believed that competitors with a fast start and the best equipment would be favoured to win the race. The addition of another challenging track that would favour skill and execution over equipment, would enhance the North American competition circuit and increase the development potential for local athletes. For the Canadian contingent, it would mean the ability to first develop skills in Calgary and then hone and challenge them in Whistler. Meeting minutes articulated an opinion that both the FIL and FIBT wished to see a challenging track. It was agreed in concept that the Whistler track should set a new standard for difficulty by being long, steep and adding challenge for athletes who would want to win at the prestigious venue. Track lengths of 1400 metres to 1500 metres were mentioned specifically at the meeting, as was a stipulation that the track should be the steepest in the world. There was no mention, however, of any specific speeds that were to be sought through track design.

In February 2004 representatives of the FIBT and FIL met with their counterparts at the Vancouver 2010 Organizing Committee and agreed on a track centreline that would be submitted to the track designer. The next step in the track development process was to engage a run dynamics expert whose function would be to analyze and fine-tune the track centreline and design track profiles.

Of the less than 20 artificial tracks used for competition around the globe, eight had been designed by the principal of the Leipzig consulting firm of Ingenieurbüro Gurgel (IBG). IBG, along with one other firm, cornered this niche market

Ministry of Public Safety and Solicitor
General

Case No.: 2010-0269-0002

**CORONER'S REPORT**
INTO THE DEATH OF**KUMARITASHVILI**

SURNAME

NODAR

GIVEN NAMES

through their unique expertise. VANOC contracted the services of Ingenieurbüro Gurgel on the basis of recommendations from the International Federations.

IBG utilized proprietary software to produce a design that included speed calculations and G-force profiles for the entire track length, accounting for the different dynamics involved in the various sliding sport disciplines. The program that was utilized for the determination of optimum curve lengths and profiles modeled a variety of scenarios involving different entrance and exit trajectories for each curve and at different speeds, resulting in up to 42 sets of calculations per curve.

The International Federations offer some general guidelines for the design of sliding tracks, including requirements for specific sections of the track, such as the end of the finish outrun where the luge must not exceed the speed of 40 km/h. Similarly, FIBT rules place an expectation that a bobsled should be able to reach a speed between 80 and 100 km/h after the first 250 metres. There are also rules that guide how much centrifugal force is allowed to be exerted in the curves and for how many seconds. Other rules address such considerations as the placement of weather protection devices; for example, directing that any pillars and fixture systems should be at a distance of 50 centimetres from the inside of the track wall. Statements provided to this investigation indicated that, other than such general criteria outlined in the Federations' regulations for all competition tracks, no additional minimum-speed or maximum-speed criteria were provided to the design consultant by either of the International Federations.

No specific instructions regarding track speeds came from VANOC, either. IBG contract documents outlined deliverables that were expected of the designer, such as the run dynamics calculations and finalization of the centreline, to be performed to a standard ordinarily achieved by consultants experienced in providing similar services. IBG was also obligated to prepare documentation for review and approval by the FIL and FIBT, and make site visits to provide input during track construction. The contract between VANOC and IBG, however, did not make any stipulation or mention of either maximum or minimum speeds for the Whistler track. VANOC staff in charge of the track development carried considerable expertise in the area of project management and facility development, but no experience specific to design of sliding sports facilities. The expectation was that all technical aspects of track design processes were to be guided by input from the International Federations.

The designer's documentation described the Whistler track as very fast and providing a high level of difficulty. According to a difficulty criterion that IBG developed as a planning tool, the Whistler track design incorporated four curves that could be deemed difficult. Top speed was not considered the sole determinant of difficulty and the criterion considered such factors as the shape and dimensions of each curve, in combination with the speed at the entrance to the curve. The same equation was used by the designer to compare the level of difficulty at nine other tracks (Oberhof, Altenberg, Cervinia, Calgary, Sigulda, Lillehammer, Nagano, Salt Lake City, Torino). According to the designer's definition, two of these tracks (Sigulda, at 8; Altenberg, at 5) had more curves with the highest level of difficulty; one (Oberhof, at 4), had the same number of difficult curves as Whistler, while the remaining six tracks incorporated curves that ranked below the designer's criterion of the highest difficulty.

Speeds at sliding tracks are mainly dictated by the elevation difference along the track and by the configuration of the curves. The steep profile of the Whistler site, in combination with the compact footprint that presented design limitations, was the key determinant of the high speeds; however, options consisting of various engineering measures would have been available for mitigating these influences, and resultant speeds, if required. The track designer indicated that a top speed or a speed limit was not requested of him, but he also understood that it was in the nature of the sport to have a faster track than the one before. The input provided to the designer suggested that the IFs were looking for a fast and

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**CORONER'S REPORT**
INTO THE DEATH OF**KUMARITASHVILI**

SURNAME

NODAR

GIVEN NAMES

difficult track, but it was the new curve configurations that were expected to provide the main challenge, and not the speed alone. It was offered to this investigation that the bodies representing the sliding sports wished to see a track that would provide a good sporting experience and lead to further development of the sport.

A number of reiterations of the design were produced by IBG, and after a series of studies and track re-alignments, the process culminated with the final version, referenced as VAR03A and dated October 23, 2004. The design included predictions of the speeds and G-forces that a bobsleigh, skeleton or luge athlete could experience in each corner of the track. The document specified a maximum pre-calculated speed of 136.3 km/h that could be expected in men's luge. Curve 11 was the fastest segment, but eight other curves were also designed to produce speeds in excess of 130 km/h. There was a safety factor built into the driving line calculations, in anticipation that the pre-calculated speeds could be exceeded in the future by up to 7%. Both IFs provided their approval of the final design. Although VANOC, as the organizer of the Games, had engaged the track designer, paid for the product, and was the recipient of project deliverables, it relied on the expertise of the track designer and the experts at the FIBT and the FIL to ensure that the final product met the needs of the sliding sports.

In November 2004 VANOC selected Stantec Architecture Ltd. to provide a detailed site master plan for the Whistler Sliding Centre facilities and to provide general site engineering services for the Centre, incorporating the design produced for the track by IBG.

In February 2005, before construction commenced at the Whistler Sliding Centre, concerns arose regarding the Cesana Pariol track built for the 2006 Torino Winter Games. During a luge test event on this recently homologated track, a series of serious crashes occurred, resulting in cancellation of the races and calls for physical modifications to the track to improve luge safety. The FIL also developed concerns that similar modifications might be required in a number of track sections at the Whistler Centre. These concerns were communicated to VANOC in March 2005, creating a certain level of uncertainty about the design of the Whistler track. After some discussions, the FIBT eventually acceded to the FIL's request for changes to track sections at Cesana that were identified by the Luge Federation as being problematic. A written agreement signed by the two IFs in June 2005 regarding the Torino track, also mentioned that all preliminary design work for the Whistler track was in perfect order and construction work could proceed without delay. Despite this reassurance, it would seem that some of the questions regarding the Whistler track remained unresolved at that time; the team responsible for track development at VANOC continued to voice concerns and urged the two Federations to reach a definitive conclusion regarding any potential track modifications prior to the start of construction. These concerns were a subject of exchanges between VANOC and the two Federations, with notification to the IOC. The uncertainties continued well into the next year and the proposed time for the start of the Whistler track construction. The final outcome was a determination that the construction could commence based on the original design and that the only required modifications would involve the lowering of a wooden track lip in a number of sections. VANOC correspondence from June 2006, addressed to the International Federations, documented that following a review of safety concerns with both Federations and the IOC, it was concluded by those organizations that VANOC should continue with track construction using the existing plans that had been approved by the Federations.

Preliminary site preparation and construction of the Whistler Sliding Centre commenced in June 2005 and the process was largely completed by the end of 2007, allowing the first test runs along a section of the track to take place in December of that year.

During the construction stage, active input was required from the technical experts at the two International Federations



CORONER'S REPORT

INTO THE DEATH OF

KUMARITASHVILI

SURNAME

NODAR

GIVEN NAMES

who made visits to the construction site and provided technical advice, including input regarding the placement and configuration of crash barriers. Although the engineering design of the track results in the final centreline and track profiles intended to result in optimum runs and keeping athletes in the track, this investigation was informed that, as typical with all new tracks, additional work was required to optimize the placement of crash barriers once the concrete profiles had been formed. More adjustments to safety features are normally made once sleds can actually be observed on the ice.

The official homologation of the Whistler Sliding Centre took place in March 2008. The homologation involved four days of testing and evaluation of the facilities by each of the two International Federations, separately. The process involved Canadian and international athletes and coaches selected on the basis of criteria developed by the IFs. The homologation process identified a number of items that still needed to be addressed at the track, including improvements to the refrigeration system, better shading from the sun, installation of additional crash barriers and extension of existing roll-over barriers and vertical walls in certain sections, and installation of guardrails to ensure safety for spectators. Compliance with these additional requirements identified during homologation was subsequently confirmed by the FIL and the FIBT during a site visit in October 2008.

The homologation process also showed that the track was capable of producing speeds that exceeded the designer's calculations by at least 10 km/h. The Chairman of the FIL Track Construction Commission remarked in his report that all ice profiles at the entries and exists of the curves, must be optimized between curve 11 and the finish, or serious crashes could not be prevented with such high speeds. He further concluded that with good ice preparation and race equipment, speeds of up to 150 km/h would be reached from the men's start.

The FIBT Homologation Report stated that due to the high speeds attained on the track, the FIBT Track Commission recommended that all pilots, in both bobsleigh and skeleton, begin their training at the Whistler Sliding Centre by using lower start positions. The FIBT Track Commission also recommended that the Centre be open for international training as much as practically possible so that the athletes could acquire enough experience to safely descend the track under race conditions.

Similar conclusions were reached by the FIL, prompting the Federation to ask the management of the Sliding Centre for additional training days, above the normal requirements under the International Luge Regulations. The FIL also required progressive training that involved three initial runs from what was known as the Novice start, two runs from the Junior start, and one run from the Lower Women's start, before a luge athlete could graduate to the Race start.

This system of progressive training was put into practice at the FIL International Training Week in November 2008, when 144 athletes from 23 nations attended the event and were given an opportunity to familiarize themselves with the track and provide further input regarding the track to the Federation. A number of crashes were observed (68 crashes in 2482 runs), but the FIL Technical Delegate also noted in his report that nobody was badly hurt. Overall, six athletes required medical attention for injuries ranging from bruised knees to low-grade concussions. The FIL Technical Delegate commented that "we have a very fast and *provokative* track but it is not at all more dangerous than some other tracks we have. The challenge with this track is to get used to the speed". Mr. Kumaritashvili did not participate in this training session.

Another International Training Week was held in Whistler in November 2009. A total of 151 athletes from 29 nations participated in this event, taking a total of 2295 runs. There were 77 crashes, with 9 athletes requiring some level of

**CORONER'S REPORT**
INTO THE DEATH OF**KUMARITASHVILI**

SURNAME

NODAR

GIVEN NAMES

medical attention, including transfers to a medical clinic for treatment of concussions. Mr. Kumaritashvili participated in this training session, taking a total of 20 runs from various starting positions, as part of the progressive training routine. He crashed in two of the runs; records showed that he did not sustain significant injuries and was able to return to training.

Earlier that year, in February 2009, both the FIBT and the FIL held their World Cup races at the Whistler Sliding Centre. These races also served as Olympic test events, evaluating the readiness of the track and facilities. Following the luge event, the President of the International Luge Federation sent a letter to the track designer, with a copy to VANOC, expressing surprise that speeds of 154 km/h had been reached and stating that the designer's calculations of the top speeds were incorrect. The letter stated that due to the excellent ice work done on the track most athletes were able to cope with these extremely high speeds, but it also asserted that "overstepping this limit would be an absolute unreasonable demand for the athletes". The FIL President also expressed a concern that the speeds at the track could be expected to increase in the following years, consistently with the pattern observed at other newly-built tracks. He asked the engineering firm for a response regarding the mistakes in the designs and calculations, particularly with regards to the next Olympic track to be designed by the same consultant for the Winter Games in Sochi.

The President of the FIL stated to this investigation that by forwarding a copy of the letter, he wanted to inform VANOC, as the organization that had contracted the engineer, that in his opinion, the track was not supplied as ordered. However, he also offered that there was no expectation on his part that VANOC would try to do anything to lower the track speeds.

VANOC management discussed the FIL correspondence in a brief series of communications, but concluded that no action was required regarding the Whistler track since the FIL's intent was simply to ensure that the Sochi track would not become even faster. VANOC's Director of Sport later indicated to this investigation that his organization's assessment at that time was that the track was indeed faster than originally pre-calculated, but there was no indication that the athletes would be unable to manage the speeds safely. VANOC saw itself as the developer and organizer that simply provided a product required by the sports organizations, based on their needs, specifications and approvals. VANOC did not have the expertise required to make decisions regarding what was appropriate for the sport of luge, but indicated that it was prepared to act on whatever was requested by the International Federations.

The track designer provided a written response to the FIL, in April 2009, explaining that the discrepancies between the pre-calculated and the actual speeds at the Whistler track could be attributed to changes in drag coefficients and ice-friction coefficients that resulted from recent developments in sliding equipment. This effect gained particular influence given high average slopes and high velocities. The engineer subsequently pointed out to this investigation that, because of the secrecy surrounding sled development, engineers experience difficulties in obtaining the latest sled specifications required for run dynamics calculations. In his response to the FIL, the engineer stated that once the run-dynamics algorithms had been updated with the new coefficients, the program's calculations closely matched the actual track speeds. He further asserted that, according to the new calculations, it was possible to use the existing Whistler track profiles up to a maximum speed of 161 kilometres per hour, without the danger of a turn-over. A copy of this correspondence was also provided to VANOC.

Evidence submitted to this investigation suggested that the high speeds were considered an issue that had to be managed to ensure safety, but the prevailing view at VANOC and at the International Federations was that this challenge would be adequately mitigated with the graduated training starts and additional training time. It was also pointed out that the percentage of crashes at the Whistler Sliding Centre was lower than the ratios at many other tracks and the severity of crashes, until Mr. Kumaritashvili's incident, was not incongruous either. Occasional crashes were not altogether

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Ministry of Public Safety and Solicitor
General

Case No.: 2010-0269-0002

**CORONER'S REPORT**
INTO THE DEATH OF**KUMARITASHVILI**

SURNAME

NODAR

GIVEN NAMES

unexpected in the sliding sports, especially at new and unfamiliar tracks where ice profiles and driving lines were still being perfected. Although some athletes expressed negative reactions to the track, others were accepting of the challenges it offered. The track was not considered dangerous by the officials at the International Federations. The speeds and the technical challenges were considered to be properly mitigated with the additional training requirements and were, in fact, viewed with enthusiasm. As more descents were completed on the track, the organizers continued to develop their confidence in the Whistler venue. By the end of January 2010, more than 30000 descents took place, including over 18000 luge runs. As typical for all recently-constructed tracks, adjustments to the ice profiles and occasionally to the protective structures continued, when previously unexpected safety issues materialized. For example, the low wooden wall, which ultimately failed to prevent Mr. Kumaritashvili from leaving the track, was erected as a result of other crashes observed in that section. The size and configuration of the barrier was determined with input from the Track Commission Technical Delegates on the basis of previously observed crash dynamics.

Opinions respecting the Whistler track seem to be deeply divided. Whereas some have questioned the speeds and safety at this venue, others insist that even though the track is extremely fast and difficult, there are no inherent safety issues. It has been offered that, once the athletes are able to familiarize themselves with this track, it becomes manageable and draws accolades. However, it has also been suggested that it is a challenging track, where once a significant driving error occurs, it is difficult to correct it.

It is not within the scope of the coronial investigation to determine whether the Whistler track is acceptably safe or not. That task needs to be left to the experts in the sliding sports, engineering sciences and perhaps some interdisciplinary fields that may be in a position to add a valuable perspective to such a query. February 12th proved that this track was capable of producing a serious incident when unfavourable factors converged. Perhaps this may also be true for other tracks, even if they have not previously been the scene of a fatality.

The analysis of Mr. Kumaritashvili's incident necessarily has to concern itself with two sets of considerations: those associated with the initial loss of control, and those related to the subsequent collisions with the ice wall and other structures. Having considered a number of factors, this investigation has come to the conclusion that it may not be possible to categorically point to a single factor, or even a distinct set of factors, and identify it as being responsible for the incident. Rather, one must accept that it was a convergence of several factors, some more apparent than others and with various levels of involvement, that culminated in this fatality.

High speed has been suggested as a key factor, but it could not be the sole determinant of the outcome; athletes have been able to negotiate this track with speeds exceeding 150 km/h. At the same time, the importance of speed cannot be dismissed altogether: A collision of such magnitude could not have occurred without high speed, and higher speeds would have required faster reaction times, making a recovery from a driving error more difficult to achieve. It is not possible to determine, without entering the realm of speculation, what factors have led to the selection of a particular driving line or a subsequent corrective response. It is reasonable to conclude, however, that high speed, in conjunction with other technical challenges presented by the Whistler track, overwhelmed Mr. Kumaritashvili's ability to surmount the difficulties on that particular run. Nevertheless, one cannot conclude that the outcome was in any way certain: Even though he did have problems on this track, including previous crashes, as did some of the other athletes, Mr. Kumaritashvili was also able to successfully negotiate this track in his previous attempts, albeit at slightly lower speeds. Likewise, other developing athletes of similar rank were able to slide down this track without such dire consequences. Ability and experience would all have a bearing, but it is not possible to objectively determine to what extent, if any, they have been contributory in this incident. Similarly, it cannot be determined to what degree the relative lack of experience on this particular track has

Ministry of Public Safety and Solicitor
General

Case No.: 2010-0269-0002

**CORONER'S REPORT**
INTO THE DEATH OF**KUMARITASHVILI**

SURNAME

NODAR

GIVEN NAMES

played a role, but it is reasonable to conclude that more exposure to this difficult track would have given Mr. Kumaritashvili a greater ability to adjust to the difficulties.

There was no evidence that any external or environmental factors played a part in this incident; for example, the weather was not contributory. Other events, such as the raising or lowering of the shades adjacent to the track, which had been suggested as a source of distraction for the athlete, were eliminated by this investigation as likely inconsequential. Video evidence indicated that the shaded portion of the lower section of the track occurred along curve 16, whereas the driving problems started prior to the entry into that curve. Further, scrutiny of the footage of the incident shows that the trackside workers only move to lower the shades at the entrance to the previously unshaded section once Mr. Kumaritashvili slides beyond them. Finally, the majority of expert opinions sought by this investigation, indicated in a manner that seemed reasonable, that even if a particular shade was being drawn as a luger went by, the relatively slow movement of the shade would not have been readily perceptible by someone sliding past that point in a fraction of a second. Inability to see the curve ahead, because of the shades, has also been offered as an explanation, but this investigation has accepted that lugers at this level of competition are able to anticipate track features such as the curves ahead of them. It may not be possible to conclusively rule out influences such as the shades, but on the balance of probabilities, it is reasonable to conclude that they have not been critical.

The condition of the ice surface, and the ice profiles, were eliminated as factors on the basis of information that necessarily, had to come from the experts at the FIL. The ice was inspected before the commencement of the training session and after the incident, and was deemed to not have been a factor. It had been monitored by technical experts from the Federation, and subject to potential scrutiny by coaches from participating teams. Evidence provided to the investigation suggested that the ice profiles were carefully monitored, to the point of mapping and tracking of ice thickness in critical track sections, to ensure consistency.

The bottom inside corner at the end of curve 16, where the inside wall met the bottom of the track, had a rounded profile that influenced the rate and angle at which the sled runner climbed the wall, ultimately affecting the trajectory of Mr. Kumaritashvili's ejection. This investigation would not be able to determine whether a different radius of transition between the two surfaces could have radically changed the outcome of the collision, or whether it would have simply resulted in an equally devastating collision with just a different trajectory.

The placement and configuration of the wooden wall that Mr. Kumaritashvili struck as he left the track, but that did not prevent him from leaving the track altogether, was clearly of significance. Luge athletes are likely to sustain serious injuries if they leave the track, and efforts are made to keep them inside. Mr. Kumaritashvili's speed and trajectory through the air was such that it would have resulted in a consequential impact against any object, including a protective barrier, such as the wooden wall, if it had been higher. The force of such a hypothetical impact, as compared to the actual impact against the steel post, would have been reduced, due to a different angle of interception. However, it would have still quite likely resulted in serious injuries, including the possibility of death. Consequently, this investigation was not in a position to assert that a higher crash barrier would have definitely prevented fatal injuries. Nonetheless, it must be concluded that as long as the possibility of an athlete leaving the track exists, a barrier is necessary in that section, as in all the other sections where such an occurrence is even remotely possible. The padding that was introduced to some of the outside posts after the incident, would not have prevented this particular death given the force of the collision, and would have been superfluous had Mr. Kumaritashvili been kept inside the track.

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**CORONER'S REPORT**
INTO THE DEATH OF**KUMARITASHVILI**

SURNAME

NODAR

GIVEN NAMES

CONCLUSION

I find that Nodar Kumaritashvili died in Whistler, British Columbia, on February 12, 2010, of multiple blunt force injuries sustained in a collision with fixed structures, in a luge incident. The collision was a result of an interaction of factors including high speed, technical challenges and exacting physical forces with the associated physiological stresses, which converged at a critical moment, overwhelming the athlete and causing the irretrievable loss of control of the sled.

The conglomerate of all the risk control measures, physical and otherwise, failed to anticipate this incident or mitigate the outcome. The relative lack of experience Mr. Kumaritashvili had on this challenging track set a backdrop for the incident and was a significant disadvantage, as far as safety was concerned, for the athlete entering the high pressure environment of the Olympic Games.

I classify this death as accidental.

Pursuant to Section 16 of the *Coroners Act*, the following recommendations are forwarded to the Chief Coroner of the Province of British Columbia for distribution to the appropriate agencies.

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**CORONER'S REPORT**
INTO THE DEATH OF**KUMARITASHVILI**

SURNAME

NODAR

GIVEN NAMES

RECOMMENDATIONS

To: Mr. Keith Bennett, President and Chief Executive Officer
Whistler 2010 Legacies Society

1. It is recommended that the Whistler 2010 Legacies Society undertake a comprehensive safety audit of the Whistler track, including, but not limited to, an independent review of the track design and track speeds, placement and configuration of crash barriers and other protective measures, to address the possibility of violent crashes inside the track and the possibility of athletes or sleds leaving the track and potentially causing injuries to the athlete, track workers or spectators.

Coroner's comments: While VANOC was formed for the purpose of planning, organizing, funding and hosting of the 2010 Games, including the construction and operation of the Whistler Sliding Centre, the Whistler Legacies Society, later renamed Whistler 2010 Sport Legacies Society, was established as a not-for-profit corporation for the purpose of operating the Whistler area Olympic venues, including the Whistler Sliding Centre, following the culmination of the Games. The Whistler 2010 Sport Legacies Society took over the operation of the Whistler Sliding Centre, from VANOC, on the asset transfer date of May 31, 2010.

This investigation recognized that some of the most acknowledged experts in the area of sliding sports and track development were involved in the creation of the Whistler track. It would also appear that the best practices known at the time were followed. However, Mr. Kumaritashvili's death has proven the Whistler track capable of producing a serious incident, despite all of the safety measures that have been previously considered adequate. Further and greater scrutiny of safety issues at the track is advisable. Consideration may be given to involving an independent and previously unaffiliated entity to carry out the audit, in order to provide either a new perspective or a corroborative perspective capable of restoring confidence in the Whistler track.

It is anticipated that such an audit would not only reflect on the safety of top-level competitive athletes, but also consider the safety of the tourist, the recreational track user, and the public in general.

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**CORONER'S REPORT**
INTO THE DEATH OF**KUMARITASHVILI**

SURNAME

NODAR

GIVEN NAMES

To: Mr. Josef Fendt, President
Fédération Internationale de Luge de Course

and

Mr. Ivo Ferriani, President
Fédération Internationale de Bobsleigh et de Tobogganing

2. It is recommended that the two International Federations governing the sliding sports review the current practices and protocols for track homologation and all other aspects of their involvement and input into track design and construction and, where possible, consider incorporating additional measures that may, for example, include a requirement for independent, safety-oriented audits of track design and construction, and the placement and configuration of crash barriers and other safety features.

Coroner's comments: It may be that risk can never be fully eliminated from the realm of sliding sports. In fact, this element of risk seems to hold its own appeal and be seen as an integral part of those sports along with the other elements of skill, concentration, strategy and athleticism. However, as much as the athletes accept that risk exists in their sport, the organizers, regulatory bodies and venue owners must ensure that no effort is spared to anticipate the unforeseeable as far as safety is concerned, and do everything possible to mitigate the risk. It would appear that the best practices known at the time have been followed in the development of the Whistler track. However, Mr. Kumaritashvili's death has shown us that the previously employed best practices have not been infallible. It is recognized that the governing body of the sport of luge continues to demonstrate its commitment to athlete safety as the most imperative objective.

While recognizing that the FIBT has reported its satisfaction with the Whistler track and its safety record in FIBT governed sports, and although the fatal incident involved a luge athlete, this recommendation is also extended to the FIBT in recognition of this organization's important role in the development of tracks used jointly by the bobsleigh, skeleton and luge disciplines.



CORONER'S REPORT

INTO THE DEATH OF

KUMARITASHVILI

SURNAME

NODAR

GIVEN NAMES

To: Mr. Josef Fendt, President
Fédération Internationale de Luge de Course

3. It is recommended that the FIL require more compulsory, venue-specific training immediately before major competitions such as the Olympic Games and in the qualifying periods before such events, with special attention to events involving newly-constructed tracks, in order to provide athletes, and particularly the developing athletes, with a higher level of comfort on an unfamiliar track, before they enter the high pressure situations of competitions.

Coroner's comments: Although we may not know Mr. Kumaritashvili's state of mind and thought processes during his final runs, it would be reasonable to conclude that he must have experienced an intense urge to succeed by having better, faster results. It is also reasonable to assume that Mr. Kumaritashvili was sliding faster than ever before in his life and was attempting to go even faster, while simultaneously struggling to learn the intricacies of the track and the dynamics it created. It has been offered to this investigation that some highly skilled and experienced lugers can "learn a track" in as little as ten or fifteen runs. That may be the case, but it would also be reasonable to conclude that the less experienced, less trained or less skilled athletes may require more venue-specific training time in order to attain their level of comfort at a particular track. Similarly, coaches may also benefit from longer exposure to a newly-constructed track. Whereas the ability to train extensively at the venue before a major competition may be linked to improved competitive performance, it must also be presumed to have an indirect effect on the safety of the athlete. Mr. Kumaritashvili's fatal incident occurred on his sixth and final training run before the competition. It could be argued that the tragic incident might have occurred even if many more training runs had been scheduled. However, it is also reasonable to postulate that more training runs may have eliminated some of the pressure and may have offered Mr. Kumaritashvili a greater level of comfort and the ability to learn the track at a pace that would provide him with a wider margin of safety. The amount of training opportunities provided at the Whistler track, including the requirements for graduated starts, had already been increased prior to the Olympics, in recognition of the difficulties and speeds attained at the track. When these requirements were put into place, it was believed that they were sufficient to ensure safety. In the aftermath of Mr. Kumaritashvili's death, it would be prudent to revisit such requirements and err on the side of caution, insisting on more, rather than less.

Tom Pawlowski, Coroner
Province of British Columbia