



# XPS Bulletin

ISSUE 13 – WINTER 2015

## EXPERT PROCESS SOLUTIONS

**Expert Process Solutions** is the new branding slogan for XPS. We are excited about this change and believe it is very appropriate in describing the level of expertise that we provide to our clients.

Many of our managers, principals, engineers, technicians and technologists are considered “Expert” in their field. This expertise is a combination of practical experience and technical knowledge. During lean economic times with low availability of capital it is essential that the operating plants optimise use of installed infrastructure and equipment to maximise revenue and reduce unit costs.

This is where XPS expertise has played a major role, for example, by performing QEMSCAN analysis on concentrator samples to determine the financial value of the grade and recovery improvements. XPS can define sampling, sample preparation requirements and perform the detailed data analysis required to prioritize and maximise value. In addition, XPS has provided mine and plant support in implementation of best practice process control solutions. It is quite common for many control systems to be underutilized, and XPS has the expertise to ensure control loops are running in automatic for robust regulatory control to implementing advanced strategies to maximise financial value of the

asset. Our Materials Technology group have provided specification of materials to new equipment, oversight during equipment fabrication and diagnosis of failures to prevent reoccurrence. Our Extractive group have some of the most innovative minds in the industry and have contributed to new process developments in pyro and hydrometallurgy and also have solid plant operational expertise.

In addition to operations support, any new greenfield projects must be resourced to target a “Type 1 start-up”. We have achieved this with our support to the Eagle Mine start-up as shown in the opening bulletin article. Your “A” process team resides at XPS, with a few centuries of experience in applying EXPERT PROCESS SOLUTIONS to the industry.

For those attending **PDAC 2015**, please drop by the **XPS Booth #615** on the Tradeshow floor.

We hope you enjoy this edition of the XPS Bulletin. Please review what our clients are saying about us in the testimonials section! We look forward to your thoughts, feedback and comments.

*Dominic Fragomeni*  
Director, XPS

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## To Receive XPS Bulletin

If you would like to receive a copy of the XPS Bulletin please e-mail your details to [rhonda.joly@xps.ca](mailto:rhonda.joly@xps.ca)

## Look us up on SAMSSA

XPS can also be found in the Sudbury Area Mining Supply & Service directory



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XPS Consulting & Testwork Services  
– A GLENCORE Company

# The Eagle Project: Developing Michigan's First Nickel Mine – Part 2

As reported in the spring 2014 edition of the XPS Bulletin, 2014 represented a significant milestone for Michigan's Upper Peninsula with the commissioning of Lundin Mining Corporation's Eagle Mine.

The Eagle Mine consists of the Eagle underground mine, located approximately 55 km northwest of Marquette, Michigan, U.S.A. and the Humboldt mill, located 45 km west of Marquette in Champion, Michigan. The mine and mill were commissioned in the third quarter of 2014, with concentrate production commencing at the end of September 2014. The mine is expected to produce an average of 17ktpa each of nickel and copper over the current mine life of eight years at an average cash cost of \$2.50/lb of nickel.

XPS' history with the Eagle mine dates back some years, when a former owner contracted XPS to develop toll milling options for the ore. Lundin's decision to refurbish the nearby Humboldt Mill in Marquette County resulted in a new round of flowsheet confirmation and piloting, in which XPS was happy to



Ball Mills at Eagle Mine's Humboldt Mill

participate. XPS completed batch testing and a mini flotation pilot plant where 12 kg/hr of ore were continuously processed and bulk concentrate of over 22% Cu+Ni

was produced. XPS succeeded in fully meeting the project objectives within a day and a half from startup, and was able, over the four day pilot campaign, to

## XPS Client Testimonials

XPS welcomes feedback on its services and expertise to help us focus our efforts for improved service. We thank all of those who have taken the time to write to us and provide this feedback. Below is a sample of client testimonials provided to XPS.

***"A quick note to thank you for your continuing support in India. I met Nicolas over the last few days and was quite impressed with his skill set and attitude. Thanks for sparing him."***

*Robert Beaulieu, Technology Director, KNS*

***"Merci Wilson. You're a gem! This is the best summary I've seen and clarifies most of the things that had been troubling me."***

*Brian Jones,  
Director Strategic Projects, KNS*



XPS Mini Flotation Pilot Plant.

***"The specialist service provided by Dominic and his group at XPS is top quality. I do not know of any facility that can combine the disciplines of mineral science and metallurgy with a strong overlay of high confidence methodology in the way that he and his colleagues can. I have no hesitation in recommending him"***

*Colin Lindsay, President, Torcastle Project Services Inc.*



test and stabilize two flowsheet alternatives above and beyond client expectations. The bulk piloting campaign was followed by a Cu-Ni separation campaign using accumulated concentrate, in which samples of final Ni and Cu concentrates were produced for testing and marketing evaluation.

The XPS contribution to the start-up did not end at lab and pilot testing. In early September, Senior XPS Consultant Gord Marrs, former Director with Glencore Ni Sudbury Ni operations along with Tony Deng, Project Metallurgist worked along-side the Chief Metallurgist Darby Stacey and the Lundin team to start up and process commission the grinding circuits and flotation plant. Early commissioning was on low grade waste. Process stability was achieved and the feed then transitioned to more typical ore grades. XPS value contribution spanned many areas, including crushing plant operation/maintenance practices, grinding circuit stabilization/power distribution and meeting grind size targets. XPS' expert knowledge in Ni flotation was recognized early from the mini-pilot plant and was used extensively to commission and stabilize the flotation plant. Along with providing direction, XPS was able to pass along key process knowledge either when on site or remotely. XPS continued to assist in the performance of daily plant balances and has responded to "911" calls when the plant personnel requested assistance.

The commissioning results were excellent. On September 23, 2014, the Eagle Project officially announced the handover of the facility to the operations team and the commencement of ramp up to design production throughput of 2,000 tonnes per day. This target is expected to be achieved during the second quarter of 2015 or sooner. By month end September 2014, 3000 tonnes of Ni concentrate and 1000 tonnes of Cu concentrate were produced with concentrate grades and recovery curves improving during the month and will continue to be a focus during the ramp up period. XPS is playing a key role in achieving metallurgical grade and recovery targets. Performance to date

***"I was impressed with the skills, capabilities and experience of the XPS staff, and they clearly have the capabilities to perform the work program identified effectively."***

*John Marsden, President, Metallurgium*

***"Thanks again for sharing your ideas and knowledge with me. I enjoyed very much the conversations. I feel re-energized. I also want to thank you for championing process control in our industry. Every plant says they want Operational Excellence but very few make the effort. Your (COM 2014, Vancouver) plenary (summary of many years of leadership and experience) is a huge help for us."***

*Eduardo Nunez,  
Senior Process Control Engineer,  
Teck Highland Valley Copper Partnership.*

***"XPS added tremendous value to Eagle by interjecting firm and sound process advice at all the right times during the ramp-up period to help 'keep us out of the ditch'. Gord and Tony each were able to help in areas of grinding, process control, flotation, Cu/Ni separation, dewatering, metal accounting, and laboratory methods – among others. Additionally, having a team of experienced metallurgists available on call allowed our team here on site avoid being burnt-out from the efforts of commissioning and ramp-up. I would cringe going into another startup without their help."***

*Darby Stacey, Chief Metallurgist – 01/13/15*

is in-line with expectations and Eagle remains on track to meet, or exceed, market guidance on metal production. Project safety performance has been a great success with the project passing 1 million man hours without a lost time injury. The first shipments of saleable concentrate took place during October 2014.

The project has been delivered ahead of schedule and is expected to be at or below the budget of \$400 million established at the time of acquisition in July 2013. Total spent since that time is \$321 million, of which \$96 million was spent in the third quarter of 2014. There will be ongoing ancillary project completion activities throughout the remainder of the year.

XPS is pleased to be part of the Eagle pre-commissioning and commissioning teams and looks forward to working with Lundin on future projects.

Contact Virginia Lawson ([virginia.lawson@xps.ca](mailto:virginia.lawson@xps.ca)) or Tony Deng ([tony.deng@xps.ca](mailto:tony.deng@xps.ca)) for further information on commissioning services provided by XPS.

***"It was a pleasure to meet you (prior to your keynote at the 12thAusIMM Mill Operators Conference 2014) – at the JKMRRC, Brisbane. I doubt there is anyone with your sustained process control experience and hard won knowledge of real world applications. Alban (Lynch) is very impressed, not an easy outcome."***

*Don McKee, Aug. 31st, 2014:  
Founding Director of the  
Sustainable Minerals Institute, Australia.*

*D.McKee,  
A.Lynch and  
P.Thwaites.*



# Geometallurgical Characterisation at XPS Consulting & Testwork Services

Geometallurgical studies define the range of mineralogical characteristics and metallurgical performance that ultimately increases the economic value of an orebody. Testing on this basis allows the geoscientist and metallurgical team to create a robust flowsheet able to treat the full range of variability in an orebody and to develop production strategies to maximise financial performance.

Geometallurgical units are ore types that possess a unique set of minerals with textural and compositional properties that produce similar metallurgical performance. The measurement of these textural and compositional properties can be performed cost effectively with modern tools such as Quantitative Evaluation of Materials by Scanning Electron Microscope (QEMSCAN), Electron Microprobe Analysis (EPMA) and X-ray Diffraction (XRD).

At XPS, geometallurgical programs begin with a review of geological and mineralogical data with project geologists to determine the potential features of interest and their geospatial distribution based upon the existing core logging database and ore model. Such a review, in conjunction with established metallurgical principals, provides the foundation to specifically select core to represent each potential geometallurgical type. Representative sampling is a key to ensuring that results of a geometallurgical study will reflect future performance once production of the orebody is underway. Testwork is based upon non-random samples that are spatially representative and that contain all features of interest (including grade and grade distribution) in the correct proportion. When ore is randomly sampled, blended and tested as one composite too early in a project, the variability within an orebody can be muted and create inaccurate estimates of concentrate

grade and recovery over the life of the mine.

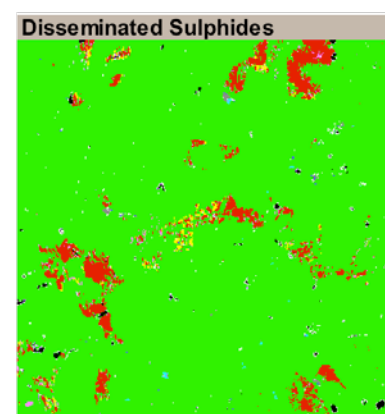
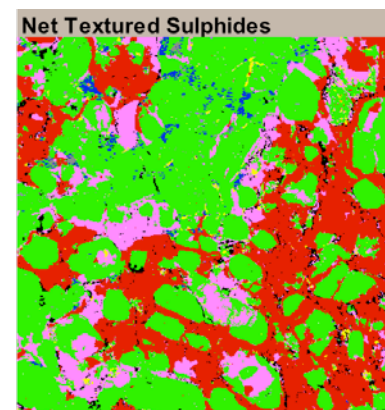
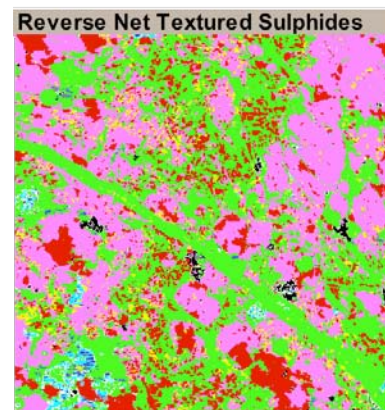
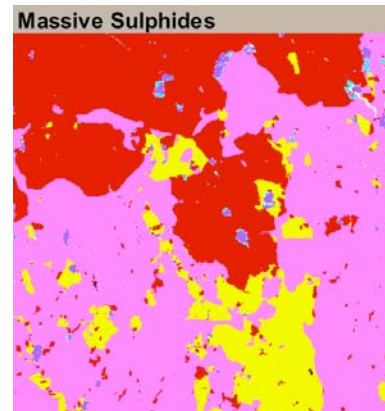
Once the geometallurgical units are established, the samples undergo mineralogical characterisation and metallurgical testing using concentration techniques such as lab scale and mini-pilot scale flotation testing and hardness/grindability testing. In addition to testing each unit using a representative composite, a variability program based on smaller samples within a single geometallurgical unit is recommended to define the range of performance that can be expected within the unit.

Sampling on the basis of geometallurgical units allow for mine design to be integrated into the economic model to maximise ROI and cash flow early in the project. This approach also provides accounting of variability, and establishes the grade/recovery profile and economics of future ores. This can ultimately lead to decisions on future process changes or blending strategies to maximise value.

For over 15 years, XPS Consulting & Testwork Services based in Sudbury, Ontario has practiced geometallurgical unit definition, measurement with QEMSCAN, EPMA and XRD technologies combined with metallurgical lab and mini-flotation pilot testing in flowsheet development and optimisation. Contact us to discuss your project needs in ore characterisation and flowsheet development.

Example of Geometallurgical Unit Textures as measured by QEMSCAN.

- Pentlandite
- Pyrrhotite
- Chalcopyrite
- Serpentine



Jorge Oliveira

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XPS  
QEMSCAN  
and EPMA





# Segregation Roasting – A Unique Process for Refractory Copper Ores

XPS recently explored segregation roasting for the recovery of copper and silver from a South American refractory copper ore. The ore, while rich in silver, posed its fair share of challenges from a processing point of view. A high carbonate content precluded the use of conventional acid leaching for extraction of the copper and silver. Further, the majority of the copper and silver occurred as very fine particles (in some cases ~10µm) locked in manganese silicates or iron oxides. An additional complication was the low copper grade (~0.9 wt%).

The ore was initially characterised by Quantitative Evaluation of Minerals by Scanning Electron Microscope (QEMSCAN), which provided a wealth of information about the minerals present in the ore and in particular the occurrence of the copper and silver minerals. This was complemented by thermal analysis in XPS' NETZSCH STA 449 TG DSC coupled to a mass spectrometer.

The laboratory testwork began with pelletizing of the ground ore with coal and salt to produce ¼"-½" pellets. The pellets were loaded into a bed in XPS' 4" diameter fluid-bed roaster, which had been modified to function as a shaft furnace. Following each roast, the calcined pellets were lightly milled to produce flotation feed. The roaster product was then floated to separate a high-grade copper-silver concentrate from the ore tailings. Ten roasting tests were carried out evaluating different roasting and flotation parameters. Ultimately a concentrate assaying over 38% Cu and 5900 g/tonne Ag was produced with recoveries of about 70-75%.

Please contact Mika Muinonen at [mika.muinonen@xps.ca](mailto:mika.muinonen@xps.ca) for more information on these and other multidisciplinary solutions for your complex process problems.



# Tailings Thickener Bed Level Measurement at Kidd Operations

XPS Process Control has been working with Endress+Hauser and personnel at the Kidd Concentrator in Timmins, Ontario, on the application of an ultrasonic sensor to monitor the level of the solids bed in the main tailings thickener.

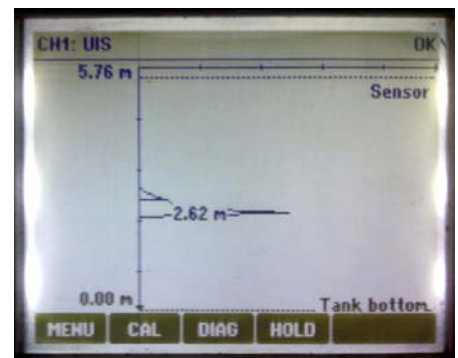
The Endress+Hauser level measurement system consists of a CUS71D ultrasonic interface sensor that is submerged 8 – 10" below the water surface of the thickener, connected to a CM442 Universal Analytical Transmitter. The transmitter processes the signals from the sensor, and can display an echo profile on its LCD screen, as well as provide outputs using various protocols for remote monitoring. In this case a traditional 4 – 20 mA output was wired to the thickener PLC to allow monitoring through OSIsoft's PI system.

Following installation, Endress+Hauser's product application specialists attended site to set up the instrument, assisted by Kidd's Instrument Maintenance and Met Tech personnel. Set up was a simple process, and the measurement was verified by use of a "Sludge Judge".

The bed level measurement has been monitored for several months, and has proven to be extremely reliable, with no loss of signal occurring during normal operation. Variations in the measurement can generally be explained by changes in the thickener operating parameters, and it has already shown the apparent existence of different operating regimes within the thickener that are well correlated to the routine operational changes made in the concentrator. The ultrasonic sensor provides significantly better information than the existing level instrument, and provides an opportunity for better control and monitoring of the thickener operation. In particular there are potential cost savings from using the level measurement to help optimise floc addition, which can only be achieved if a robust measurement is available.

In 2015 this installation will be made permanent, and XPS will assist Kidd in evaluating the application of a similar system to their concentrate thickeners.

Alan Hyde  
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# Training on 'Introduction to Process Control' at Glencore Brunswick Smelter

XPS Consulting & Testwork services in collaboration with Summa Control Solutions Inc. offered a three day training course on Introduction to Process Control at the Glencore Brunswick Smelter from September 16-18, 2014. Sigifredo Nino from Summa Control Solutions conducted the training assisted by Naseeb Adnan from XPS.

The training was well attended by 13 participants. It covered a variety of topics including fundamentals of process control, instrumentation essentials, PID control algorithms, different tuning criteria, performance and robustness, etc.

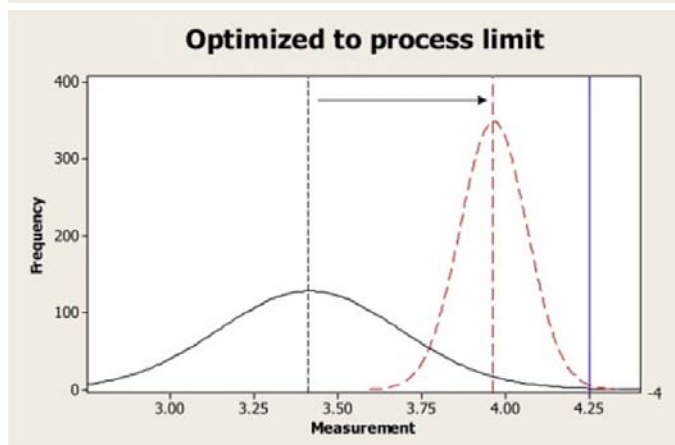
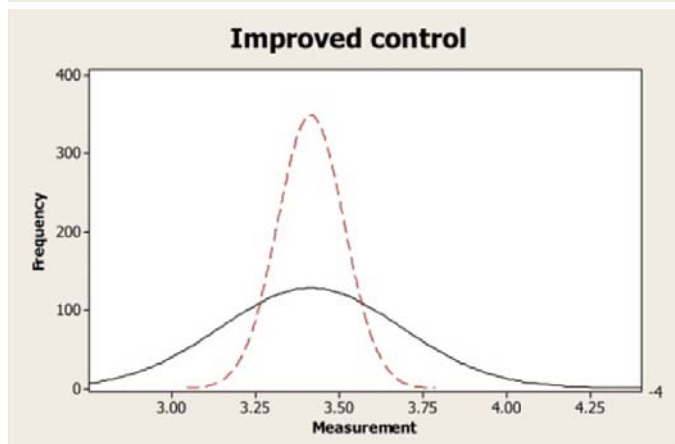
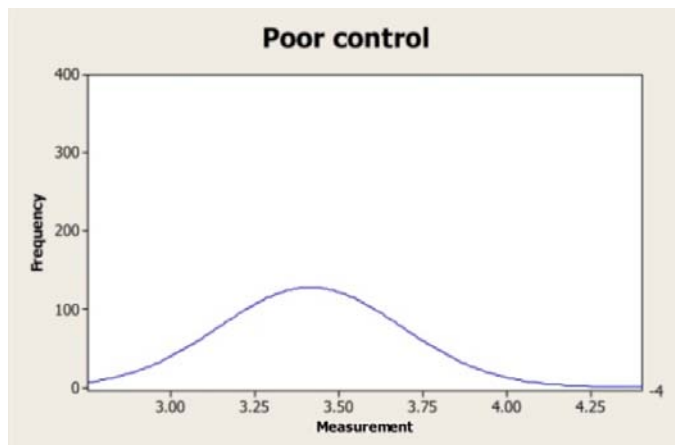
Here is some feedback from attendees:

- “I would like to have the opportunity of more training with Sigifredo with practical tuning exercises to be able to benefit from his great knowledge on tuning”
- “Everything was explained and demonstrated well. Some of the concepts were beyond my current experience and knowledge base, but the indepth explanations helped with understanding”
- “We have several control loops that need to be tuned, I know more about different methods to use on tuning”,
- “This course will improve communication and understanding of process issues between electrical and process engineering groups”
- “Instructor provided a good balance of theoretical background and practical examples and experiences”

XPS can offer similar training courses at your site or the XPS Centre.

Please contact Phil Thwaites ([phil.thwaites@xps.ca](mailto:phil.thwaites@xps.ca)), Manager of Process Control, for more details.

*Naseeb Adnan and Sigifredo Nino*





# A Course on Operation & Maintenance of Industrial Pumps

XPS Consulting & Testwork Services is pleased to offer a course on "Operation and Maintenance of Industrial Pumps" for another year in Sudbury, ON, Canada. In 2012 and 2014, the course was attended by participants from Sudbury Integrated Nickel Operations, Kidd, XPS, Vale, Bestech, Goldcorp, Barrick, AuricoGold, Imerys Talc, IFC Pumps, MIRARCO and others.

*"The concepts are simple, but the emphasis and application are invaluable."*

Whether you're a Mechanical or Process Engineer, Operator or a Maintenance Technician in the Mining, Paper, Power, Petrochemical, Food or Pharmaceutical Industries, you can benefit from a Pump Course / Workshop from XPS.

We work with some of the best eXpert instructors in the world to bring Best Practice to Pump Design, Operation and Maintenance to key members of your Site's team.

The Workshop will develop your skill-set to diagnose process pumping problems and optimise control.

Larry Bachus, better known as "The Pump Guy" travels all over the world both as a pump consultant and a seminar presenter. He is an inventor, writer and a lecturer based in Nashville, Tennessee. Larry's training has helped develop our skill-set in the diagnosis of process pumping problems and control. A couple of his reference books are: **"Everything You Need to Know About Pumps,"** published by Bachus Company, Inc. and **"Know and Understand Centrifugal Pumps,"** published by Elsevier Science (ISBN# 1856174093).

Ross Mackay is internationally recognised as a Specialist in Pumping Reliability, helping Companies reduce their pump operating and maintenance costs. His unique breadth of experience in pumps, seals and pumping systems has been gained through extensive international exposure to various industries in 33 countries. Ross is a popular speaker at major conferences. **"The Practical Pumping Handbook"** together with **"12 Steps to Mechanical Seal Reliability in Centrifugal Pumps"** and **"5 Costly Mistakes Almost every Company makes ..."** are just three of his popular books.



Larry demonstrating how Head affects Pump performance



# A Course on Operation & Maintenance of Industrial Pumps

**Course Duration:** 2 - 4 days

**Learning Outcomes:** The course combines practicality with theory in such a way that any pump user can prevent pump failure and reduce the cost of pump ownership.

**A Good Fit For:** Operations & Maintenance personnel, Maintenance Supervisors, Reliability Engineers, Process Metallurgists, EITs and Mechanical Engineers.

**Sample Course Content (not a complete list):**

- Basic Pump Principles
- Pump and Motor Alignment
- Bearings
- Mechanical Seals
- Pump Shaft Packing
- Failure Analysis of Mechanical Seals
- Avoiding Wear in Pumps
- Common Sense Failure Analysis
- Troubleshooting

**Course takeaways:**

- Learn how to separate symptoms from problems.
- Learn how to design to avoid problems.
- Learn how to operate and maintain to avoid problems.
- Course workbook, valuable reference resource, and contacts.

**Course Fee:** **CDN \$1,650** (2 days) or **\$2,450** (4 days). The course fee covers lunch.

**Course Dates and Location:** **2nd Quarter 2015**  
XPS Consulting & Testwork Services, Falconbridge, Ontario, P0M 1S0.

**Registration:** Seats will be limited, so please register as early as possible.

To register send an email to Tara Rana at [tara.rana@xps.ca](mailto:tara.rana@xps.ca) or [info@xps.ca](mailto:info@xps.ca). Please identify account code, PO #, or alternative method of payment in the email.

*Registration will be confirmed upon receipt of payment. There is no cancellation charge provided XPS is notified at least 10 working days in advance of the course. If there is withdrawal less than 10 working days before the course there will be a cancellation charge of 50% of the course fee. The full fee is payable if the registrant fails to attend without notice.*