

The Voice of Ontario's ELECTRICAL CONTRACTING INDUSTRY

The Ontario
ELECTRICAL CONTRACTOR **ECAO**
ELECTRICAL CONTRACTORS
ASSOCIATION OF ONTARIO

Volume 42 • Number 1 • Winter 2004



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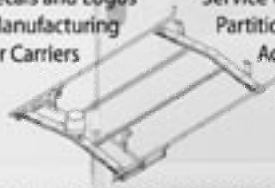
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Above: Peter Olders (left), IBEW Construction Council of Ontario, Gary Lehman, G.W. Lehman & Associates and Tim Lennard (right), Net Electric, discuss industry issues at the ECAO booth at PMExpo, Canada's largest property management show.



Left: The ECAO booth at the PmExpo show, which took place in Toronto from December 3-5.

CHANGE IS GOOD

By Dave Mason

It seems only a few months since I was elected ECAO president. At the time I said we would stay the course set by my predecessors and stick with the core association business for a year or so. "Let's just get the no-strike proposal and the 2004-2007 collective agreement renewed," I said at the annual meeting. While that was the prudent thing to say and do (and we are well on our way to fulfilling these immediate goals) it did not take into account that "change happens" and must be accommodated and managed.

Since becoming president of ECAO, elections have been fought at the municipal and provincial levels resulting in wholesale change in governments and an apparent shift in attitudes towards business generally and the development and construction industries in particular.

The energy sector experienced the August 2003 blackout, government sponsored electricity price increases, and a new regime of regulators at the Ontario Energy Board with a new set of strategic priorities.

ECAO, with its extensive government relations agenda, is now fully engaged in reestablishing itself with the province as a key stakeholder and acquainting the new Liberal government with the industry's policy agenda on licensing, apprenticeship, utility competition and labour relations. ECAO Human Resources Specialist, Gary Robertson, has contributed an article to this outlining the challenges and opportunities ECAO faces with the new provincial government in advancing our cause.

Continuing with the theme of change, Bob O'Donnell writes about the real cost of change orders on electrical projects and introduces us to the *Change Order Users Guide*. The guide is under consideration by ECAO and the Canadian Electrical Contractors Association as the standard document for pricing change orders.

In addition to external forces, ECAO has experienced internal staff changes requiring the association to reinvent its public relations function, including the publication of this magazine. Since 1952, the *Ontario Electrical Contractor* was largely published in-house. This issue marks the first time the association magazine has been contracted out. In 2004, ECAO joins with MediaEdge, a leading construction industry and association communication firm, to bring you a new and improved association magazine. We are very excited with the possibilities arising from this new partnership and magazine format. The new *Ontario Electrical Contractor* will represent contractor interests, showcase contractor achievements and educate and inform contractors – fulfilling its mission to truly be the official voice of Ontario's electrical contracting industry. So read and enjoy. I think you'll agree that...change is good.



new products

**Moeller Introduces MFD-Titan**

Moeller Electric's MFD-Titan combines the functions of a display and operator unit in one device. Operations are made directly on the device quite simply without any accessories, PC or even any training. Get up and running quickly with the MFD-Titan as it understands the industry standard ladder logic programming language. The MFD-Titan enables you to input, indicate and implement values, texts, date and time, seven segment digits, graphical elements such as company logos and machine parts, fault signals and operating sequences as well as animation.

Modular in construction, each individual module has a display, a power supply with central processing unit as well as the optional inputs and outputs. Mounting requires only 2 x 22.5 mm standard fixing holes. Termination is simple and reliable via cage-clamp spring-loaded terminals. The individual modules are simply plugged together. This saves time and money with installation and no tools are required.

The corresponding I/O modules have eight digital and four analog or digital inputs as well as an analog output and four transistor or relay outputs. In addition, the proven expansion modules of the easy control relay can be used locally or in a distributed fashion.

The MFD-Titan offers straightforward point-to-point connection with an Easy800 or an

MFD-Titan via the serial interface, straightforward communication in the EASY-NET with up to eight stations comprising of MFD-Titan and/or Easy800, and straightforward communication with up to four difference bus systems – AS-Interface, Profibus DP, CANopen, and DeviceNet. The ergonomic design combines optimum convenience with high functional versatility. Degree of protection is IP65, ideal for harsh environments. Simple and individual inscriptions via customized bezeling make the MFD-Titan an ideal product for OEM's.

Further information on the MFD-Titan is available by e-mailing info@moeller.ca.

New E4 Infrared Camera

The new model E4 assures the industry performance leadership of the lightweight, ultra-portable ThermoCAM E-Series of IR cameras. The new E4 model introduces a revolutionary radiometric jpeg image format that allows image post-processing on the camera or on a PC. It also provides three independent, movable spot temperature cursors, and audible alarming for high, low and temperature-difference thresholds. Earlier E-Series cameras are fully upgradeable to E4 specifications.

"The ThermoCAM E4 embodies several significant steps forward in the performance of handheld IR camera design," says Thomas Scanlon, director of Americas Thermography Products at FLIR Systems. "Never before has the thermographer been provided with so many time-



saving conveniences by a highly accurate, easily carried IR instrument. With the E4, thermographers can complete plant and distribution system inspections and process monitoring more rapidly, accurately and conveniently than ever before.”

The E4 introduces a radiometric jpeg file format that integrates thermographic functionality with the familiar, world-standard jpeg file format used in Web and other graphics environments. The E4 stores images as radiometric jpegs, which can be inserted into standard computer applications like any ordinary jpeg image, and also retain full thermographic functionality. As a result, they can be readily inserted into standard work processing and desktop publishing applications and can also be analyzed on the E4 itself or on a PC after downloading using ThermoCAM Reporter or other thermographic post-processing software. This capability makes life easier for thermographers

in the field, especially under stressful conditions. All the thermographer has to do is point-freeze-store crisp images, which can be analyzed and manipulated later.

The E4's ergonomic soft-button interface allows the thermographer to manipulate a frozen or saved image on the camera, to move or reconfigure cursor spots, change the temperature scale, change the palette and much more. Inspection findings can be documented by simply copying images into any word processing program.

The E4 introduces another useful, time-saving feature with an audible beep alarm that goes off when a user-defined high, low or differential threshold temperature is reached in an area or in a spot selected by the operator. The thermographer simply scans and the camera beeps when the threshold temperature has been reached within the field of view.

The E4 can measure three spot

temperatures anywhere on the thermal image. This allows not only hot spot data to be collected but also temperature reference or background data. Optional ThermoCAM Reporter software can measure five temperature spots and five areas on images downloaded to a PC.

The E4 is engineered for optimal accuracy with unique features such as ambient temperature compensation (ATC) and premium quality optics and can measure temperatures from -20 C up to 900 C. Weighing only 1 ½ pounds with rechargeable batteries, the E4 is easily carried and is 25G shock-rated and sealed for use in the harshest industrial environment. Like a cell phone, the E4's battery can be conveniently charged while still in the camera by plugging into AC or a 12V vehicle accessory socket.

The built-in Laser LocatIR laser target designator helps users associate the IR image displayed with the actual physical target. This innovative feature enhances worker safety especially in high voltage electrical environments. Because of its high performance detector, the E4 is a real-time camera and scans at the standard video rate of 60 Hz. This scan rate allows the operator to scan fast moving objects like rotating equipment or scan while the camera is moving without image smear or distortion, and record findings in standard video. Still images captured in the field can be easily transferred to a computer via USB and serial port connections.

For more information or to take a virtual factory tour and see examples of IR in use, visit the website www.flirthermography.com/e-series.

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TORONTO GETS IMPRESSIVE NEW AIRPORT TERMINAL

By Angela Altass

Toronto Pearson International Airport is undergoing a 10-year, \$4.4 billion development program that includes the construction of a new passenger terminal, which has already been dazzling those who have had an opportunity to preview this "T1-New" terminal.

T1-New consists of four main levels in a central passenger processing facility and five pier areas. Wide open spaces combine with natural light throughout the new 2.8 million square foot terminal building while on the departures level, approximately 258 check-in counters are clearly identified by columns that indicate domestic, transborder or international flights. The information technology project for the new

terminal includes a baggage tracking and reconciliation system, which uses portable scanners to assist in locating bags by recoding the container number and the aircraft belly position.

A new automated people mover (APM) is planned to shuttle passengers between terminals and the GTAA's reduced rate parking lot at the airport. The APM guideway will be approximately one and a half kilometers in length and stand 20 to 25 metres above ground level. The electrically run, fully automated APM vehicles will be clamped to a steel cable that runs along the guideway, propelling the cars back and forth without the need for traditional motors. Scheduled to be operational by December 2005, the APM will have

the ability to carry as many as 2,150 people each way every hour.

Even the new parking garage for the terminal is impressive. The garage combines new and existing technologies, including overhead signs that notify cars entering the garage which floors have available parking spaces. Once cars reach the correct level, signage at the end of each aisle will indicate how many empty spaces are available. Detectors placed above each parking space record whether that space is occupied and sends a message back to the computerized signage system.

The airport development program consists of four major projects and was initiated in 1998. The program sees the construction of the new pas-



senger terminal and access roads, a parking garage with approximately 12,600 spaces, airside improvements that include the addition of two runways, relocated and expanded cargo facilities and the expansion and relocation of other ancillary support services. Conducting all of this work without negatively impacting the ongoing day-to-day operation of Canada's busiest airport could be considered to be a daunting task. However, those who are working on the project seem to be taking it in stride. Operations at the airport have continued without disruption with all three terminals remaining open and accessible.

"This is the largest construction project in Canada and possibly in North America," says Paul Sheridan, vice president of operations with The Plan Group during an interview at his on-site office. "We have 60 people in our office to coordinate everything and there is a planning department to organize manpower and detailed schedules. There are six people who do labour control and planning and 10 CAD operations as well as 11 es-

timators. There are 100 foremen on the job. At peak times of the project, we have had 620 people working on site. One of the key things is safety and we have full time safety officers on site. We are using a fleet of 450 man lifts. There are 30,000 light fixtures, 11,000 fire alarm devices,

1,200 security doors and over 1,600 distribution panels. Power is available to the building from four different sources with four generators for backup and a UPS system to protect critical loads."

Security is an extremely important aspect of the project, says Sheridan.

"Each system is interfaced, including fire and security, with the building management system and everything is controlled and monitored here on site and also from a remote location. Everything is automated and the latest in engineering. The lighting fixtures are all custom designed and are uniquely designed for each application. The fire alarm system is integrated into the PA system with some speakers that reach 20-feet tall."

The first stage of the terminal development project sees the opening of Piers D and E of the new terminal building in April. Once this is operational, demolition of the old Terminal 1 will take place. The second



feature

stage, which includes the addition of Pier F onto the new building and the partial demolition of Terminal 2, is scheduled for this summer. Work on the addition of a Pier G is anticipated

to begin following the completion of Pier F and the entire project is expected to be complete by 2008.

"The Plan Group is involved in work on the base power lighting,

power lighting for the piers, fire alarm control for the entire complex, security, building management system, GTAA tenant fit out, Air Canada tenant fit out and some of the restaurants and stores that are part of this project."

The project is interesting in its sheer magnitude and also the architecture, says Sheridan.

"Nothing is straight," he says. "Everything is curved. There are no imbedded conduits. Everything is surface. The new terminal is a very impressive building. It is very safe and user-friendly."

All of the electrical contracts on this project have enjoyed a good relationship with the union and there have been no major labour issues, he adds.

"This is a huge project and there has been good cooperation between labour and union," says Sheridan. "Contractors are making special efforts to make sure the workers are operating in a safe environment."



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The New Liberal Government In Ontario: CHALLENGES & OPPORTUNITIES FOR ELECTRICAL CONTRACTORS

By Gary Robertson

A new government has just been installed at Queen's Park along with a long list of promises to keep and favours to repay. The Electrical Contractors Association of Ontario (ECAO) has been very active both prior to the election and during the campaigning to ensure that our members' interests remain at the forefront with MPP's.

Let's review our issues, our proposed solutions, and the new Liberal platform as it relates to our strategic vision of the preferred future.

Apprenticeship reform has been, and remains to be, of significant importance to our industry. The current Provincial Apprenticeship Committee is dysfunctional and the ministry continues to be unresponsive to our consistent request for reforms to the Certificate of Qualification (C of Q) and training standard. Previous governments split the industry with the establishment of two standards/acts and we saw an erosion of our trade with the creation of "skill sets training."

The new Liberal platform has clearly earmarked apprenticeship as a key issue. They have committed to work with the community colleges, the private sector and unions to promote skilled trades and create more learning opportunities for high demand skills and jobs, including doubling the number of apprentices in Ontario over the next five years. This is to be accomplished through the expansion of co-op placements and apprenticeships resulting from the creation of a more integrated system for those entering the skilled trades such as on-the-job learning in areas where there are skill shortages.

Our mission is to ensure that there is not a further move to break-up

the trade into skill sets and ensure that whatever actions are taken, they seek our advice and assistance prior to implementation. The Ministry of Training, Colleges and Universities (MTCU) has not supported compulsory trade certification in the past and certainly the current Liberal platform does not appear to differ.

One of the strategies identified by ECAO members to assist in furthering the qualifications of the C of Q is the proposal that the Electrical Safety Authority (ESA) becomes the authority to maintain the credentials once they are granted from the MTCU.

This proposal fits nicely with our next key issue, the establishment of mandatory provincial licensing under the authority of the ESA. Prior to the election, we were very close to having legislation introduced that supported our recommendations. Now we must re-educate government officials on the benefits of our shared industry vision.

We were encouraged to see specific mention made in the Provincial Auditors report on the activities of the ESA as they relate to licensing of electrical contractors. Specifically the report made the following recommendation:

"The Ministry and the ESA should work with other stakeholders to develop consistent standards for the training and initial and ongoing licensing of electricians working in Ontario."

Initial discussions with the office of the new Minister of Consumer and Business Services, Jim Watson (Ottawa-Nepean) have resulted in positive feedback on this initiative.

Fair competition by utilities on the contracting out of utility work continues to be the single largest concern of our members involved in the utility

sector. It is also of importance to all the ratepayers in the province in that there needs to be a process to ensure that energy fees are for generation and transmission only and do not include costs to subsidize utility owned services that compete with our members.

The Liberal platform clearly outlined several points with respect to energy infrastructure investment. They committed to encourage business to use co-generation by ensuring they have access to reliable back-up energy and fair access to sell any surplus energy.

In addition, there is a plan to replace coal-burning plants with cleaner energy sources by 2007 and expand power generation at Niagara Falls.

It certainly appears that there may be several business opportunities in the power sector for our members in the very near future.

ECAO is also monitoring several other announcements made by the new Liberal Government including converting the Red Tape Commission to make it an agency specifically devoted to meeting the needs of small business. This may prove to be very helpful in the very near future.

As most contractors are no doubt aware, we continue to struggle with workplace safety and insurance issues, so we are cautiously optimistic with the Liberals' promise of an independent audit of all Workplace Safety & Insurance Board (WSIB) operations.

All in all, a new government provides us with many challenges as well as opportunities. 2004 promises to be a very interesting year.

Gary Robertson is Human Resources Specialist with the Electrical Contractors Association of Ontario. He can be reached by e-mail at groberston@ecao.org.

347 VOLT LIGHTING SYSTEMS

By Ted Olechna

347 volt circuit is commonly used in industrial, commercial and institutional settings for lighting application. The reason for this circuit's popularity is in its assumed economic viability. First, 347 volt circuit can accommodate more light fixtures than 120 volt circuit per branch circuit. Second, 347 volt circuit can be directly wired to the building with no need of a transformer. The same cannot be said of other voltages.

When installing lighting equipment, in other than a dwelling unit, there are a number of basic rules in the *Ontario Electrical Safety Code* that

7.5 m and shall have an ampacity no less than the rating of the luminaires that the tap conductor feeds.

Subrule 4-034(4) requires that the continuity of the identified conductor in a multi-wire branch circuit be independent of device connections such as lampholders, and ballasts, so that devices may be disconnected/removed without interrupting the continuity of the identified conductor. This implies that identified terminals lampholders or other devices should not be used as feed-through mediums and that a tap-off means to the device terminations should be used.

the size of neutral conductor should be recalculated considering the total unbalanced current including both unbalanced load current and zero sequence harmonic currents.

However, working with 347 volt circuit has inherent risks and potential danger that has resulted in fatalities and injuries. Typically, many industrial and commercial lighting installations operate at 347 volts and do not have individual area switching. The lack of switching makes it difficult to de-energize the circuit when performing maintenance such as ballast changes. As much as working with energized lines is the last resort for most electrical applications, it is very much a part of the norm when working with 347 volt circuit. Typically, this circuit is of a multi-wire branch type and many facilities use a single-pole breaker for a block of lights. This presents a potential hazard.

Multi-wire branch circuits utilize a common neutral conductor (identified conductor) as permitted by rule 4-024. By switching a single-pole breaker 'off,' the circuit de-energizes only one branch of the circuit while leaving the other two branches energized. The continuity of these two-branch circuits is maintained by the common neutral conductor. If the continuity of the neutral conductor is interrupted while other branch circuits are energized, any accidental contact with the neutral conductor will effectively connect the person to ground, thus completing the circuit and electrocuting the worker.

working with 347 volt circuit has inherent risks and potential danger that has resulted in fatalities and injuries

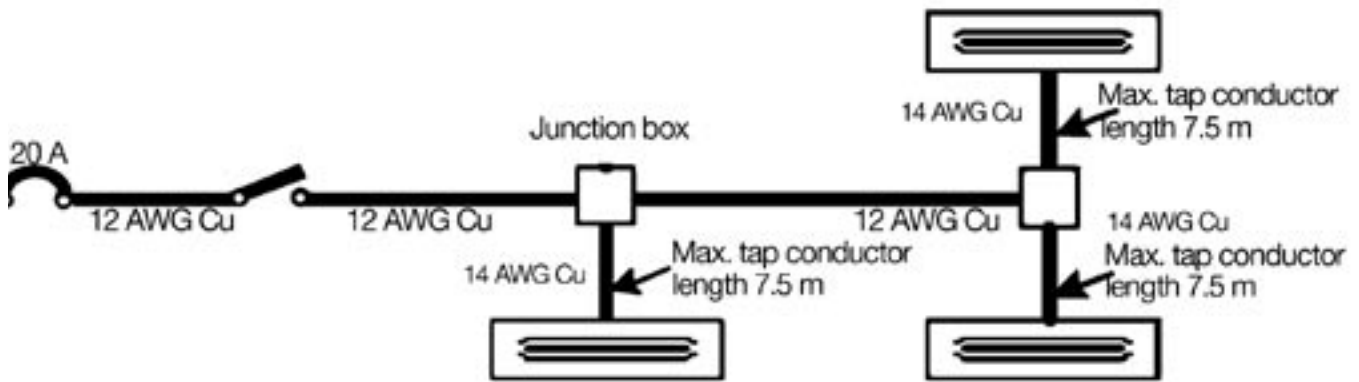
have to be followed. Rule 30-104 requires that luminaires, lampholders, and lighting track shall not be connected to a branch circuit unless it is protected by an overcurrent device rated or set by:

- 15 A where the input voltage exceeds 347 V nominal, or
- 20 A where the input voltage does not exceed 347 V nominal.

Rule 30-110 requires that all non-current carrying metal parts of luminaires and associated equipment shall be bonded to ground. In lighting branch circuits, rule 30-412 permits a tap conductor sized no smaller than a No. 14 AWG be used from a 20 A branch circuit to feed single luminaires or end-to-end mounted luminaires. The No. 14 AWG tap conductor shall not be longer than

In addition, rule 4-022 outlines how the sizing of the neutral conductor shall have sufficient ampacity to carry the unbalanced load. The unbalanced load may be comprised of two components: unbalancing in the phase loading and harmonics produced from non-linear loads.

It is essential that the neutral conductor in new 3Ø 4 wire electric discharge lighting installations be sized to handle the unbalanced load currents that are created by any unbalanced loading conditions together with the harmonics generated by connected non-linear loads. Electric discharge lighting includes fluorescent and high intensity discharge lighting (e.g. Metal Halide). In the case of existing installations where there may be harmonic concerns,



Continuity of the neutral conductor can still be achieved without interruption, providing that it is independent of the device connection. Subrule 4-034(4) in the *Ontario Electrical Safety Code* requires that tap-off means (i.e. tails) be installed so that the device could be disconnected/removed without interrupting the continuity of the neutral conductor.

A single-pole breaker only terminates power from one end. In most cases, it is cutting power from the 'positive' side. Since 347 volt circuit connects neutral to ground, it is possible for current on the neutral side to backfeed to the circuit, making the neutral 'live.' Any accidental contact with the neutral wiring will effectively connect the person to ground, thus completing the circuit and electrocuting the worker.

Furthermore, work with 347 volt circuit is performed in an enclosed/confined area with metal surrounding. Hangers, light fixture boxes and acoustical T-bar ceiling are all made of metal. The potential of electrical contact with the surrounding is high. Thus, extreme caution is required when working with such an enclosed area.

Installing New 347 Volt Lighting Systems

When working with 347 volt lighting

systems, the following is recommended:

Lay out the circuits so that no single area is fed from a single branch circuit or switch, making it safer for the person servicing the area. You might also like to consider feeding the lighting circuit from a 120/208 V system, or utilizing luminaires that are plug connected. You may make it safer for yourself if you have to service the luminaire and circuit at a later date.

When servicing 347 volt lighting systems:

- Always work with de-energized lines. Not only is it safe practice, but subrule 2-304(1) and regulation 851 made under the *Occupation Health and Safety Act for Industrial Regulations* section 42(1) is to be followed and requires that the power supply to electrical installations, equipment or conductors shall be disconnected, locked out of service and tagged before any work is done, unless it is not practicable;
- Plan your work, make arrangements to de-energize circuits at times when they will least affect the occupants – i.e. lunch breaks, after or before hours;
- Take special precaution and respect the hazards of electricity; 347 volt systems are not forgiving;

- Always treat the neutral as energized unless it has been verified as de-energized;
- Always shut off and tag out circuits you are going to be working on;
- If in doubt, ask. Ensure that all hazards are known and are minimized;
- When circumstances require working live, because it is not practicable or practical to de-energize, rule 2-306 and OHS Regulation 851 in section 42.1 requires you to minimize all factors that can lead to injuries. Always use access equipment that is non-conductive and with good insulating properties, such as non-conductive ladders. Hand tools must also be non-conductive. Drape an insulating blanket on the light box and maintain distance with other surrounding metal items such as ceiling tracks and hanging wires. Always use CSA approved rubber gloves with a minimum of class zero classification.

For specific rules and additional information on this topic please refer to the *Ontario Electrical Safety Code*, the Bulletins and Flash notices.

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THE REAL COST OF CHANGE ORDERS

By Bob O'Donnell

Changes have always been an inevitable part of the construction process. In today's economy time and financial constraints on the planning, executing and delivering of projects has put extreme pressure on the management of changes, particularly as they get more complicated.

Conflict and confusion among and between owners, architects, consultants, general contractors and sub-contractors now appears to be as inevitable as the changes themselves. For electrical contractors, the handling or mishandling of changes has become a source of great frustration and they have become one of the most frequent complaints and concerns raised by our members.

Most prime contracts give owners and their consultants the authority to direct changes to be completed without

project and diligently document those costs for eventual presentation to the owner.

The CCDC-2 Standard Prime Contract, which has been agreed upon by representative bodies from all sides of the construction industry, prudently provides limitations as to what costs contractors can include in change orders. It has become apparent in the last few years that many owners and their representatives do not think these limitations are narrow enough and prudence has now

moved to the ridiculous. Our association has received numerous examples of supplementary conditions that impose unreasonable, and without merit, limitations on what and how much

trade contractors can include in change orders.

We have seen specific discounts required for materials, specified labour rates that are below actual costs, labour costs defined as overhead, job costs defined as overhead, and specific cost items that will not be accepted. We have even seen a specification in Toronto that stated that contractors could not charge for small items. Are we to sup-

For electrical contractors, the handling or mishandling of changes has become a source of great frustration

a change order being signed and price being agreed upon. This puts trade contractors in the precarious position of having to complete work without knowing how much and when they will be paid for it. Knowing that the price still must be accepted, contractors must also be very aware of all the costs associated with a particular change, plus the impact cost of the change on the rest of the

ECAT's Change Order Users Guide

Over the past few years, members of the Electrical Contractors Association of Toronto (ECAT) have been raising concerns on how owners and their representatives are negotiating and approving change orders.

The common thread through all concerns is a true lack of understanding of owner representatives to the actual costs of changes. Adding to the confusion, trade contractors present the pricing of change orders in different manners.

To assist both contractors and clients, ECAT developed a *Change Orders Users Guide* to serve as a standard format for pricing changes. It identifies all costs associated with performing changes and how these costs should be calculated. The guide also clearly separates what should be considered labour costs, and therefore part of the hourly rate, and those items that are job expenses, which would be charged as a percentage on the total of hours and material. Similarly, the guide identifies what should be considered job expenses relative to overhead.

"We see the guide being used both by contractors and clients," says Bob O'Donnell, executive vice president of ECAT. "It should provide an arbitrary mechanism to price change notices as well as a tool for clients to effectively review the pricing they are receiving."

The guide is available from either the ECAT or ECAO office.

pose the client didn't want the lug-nuts, couplings, connectors, and etc. required to complete the change?

The most prevalent abuse is the consistent low-balling of mark-ups for overhead and profit. In its guideline for determining the costs of change orders (CCA 16), the Canadian Construction Association recommends that the mark-up for overhead and profit for work done by one's own forces should be 20 per cent. In its recent survey of electrical contractors' financial performance, the National Electrical Contractors Association in the United States found that the average overhead expense was 16.02 per cent and profit was 3.86 per cent. We somehow doubt that the construction industry is so radically different in Canada.

The Electrical Contractors Association of Toronto and others have challenged many architects and consultants to produce the research and evidence to backup many of the

limitations in their specifications. To date, we have not had a response that clearly validates the specifications as industry benchmarks.

It is an absolute must in the modern day of construction that there is close cooperation between owners, architects, consultants, general contractors and specialty contractors. Electrical contractors clearly understand the perils and escalating effect changes have on the cost of a project. It is imperative that owners and their representatives equally understand at the outset of a project that there will be real costs for trade contractors to complete required changes and these contractors will have to be adequately compensated.

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001: ACETYLENE AND FUEL GASES

Facts About Fuel Gases

All fuel gases catch fire easily. A spark or heat source can set them off, but red heat isn't necessary for ignition – some of these gases ignite at just 600 F.

Air containing between 4 per cent and 74 per cent hydrogen is explosive. You've probably heard of the Hindenburg disaster, in which a hydrogen-filled airship in New Jersey essentially behaved like a bomb.

Air containing from 2.6 per cent to 80 per cent acetylene is explosive.

Liquefied petroleum is usually compressed to 300 PSI. Hydrogen is compressed up to 2000 PSI.

At 25 PSI, acetylene is unstable and can explode without an ignition source. But, adding porous acetone to an acetylene cylinder safety permits higher compression.

Acetylene is usually compressed to 250 PSI – well beyond its stability point of only 25 PSI. Thus, the acetone is critical to safety.

Heat deprives acetone of its ability to hold acetylene.

Acetylene cylinders have fusible plugs that will melt at about the boiling point of water.

Cautions

If an acetylene valve freezes up, thaw it with lukewarm water. Pour the water over the valve, not the cylinder.

Never use a flame to thaw a valve on an acetylene tank. Doing so is dangerous when using any compressed gas, but it is especially dangerous when acetylene is present.

Because compressed fuel gases and acetylene are liquid while under pres-

sure, keep the cylinders positioned so that the valve is up. Otherwise, you may release shots of liquid, rather than gas. The liquid will subsequently expand and produce a pronounced concentration of gas.

If you do release a shot of liquid from a compressed gas cylinder, shut off the valve immediately. Ventilate the area to remove the gas. If the amount released was significant, report to your foreman that gas levels may be beyond safe limits.

Don't rely on a gas meter reading to determine whether an area is free of explosive gases. You must know the nature of a given gas and know where to look for it with the gas meter. It is easy to get a false reading if you do not have training specific to using a gas meter for a particular gas.

Fuel gases and acetylene are much heavier than air. In the event of a leak, these gases will tend to sink, relative to the environment. They will fill depressions in the floor, fill toolboxes, and generally replace the safe air in lower elevations. If you check for these gases with a gas meter, look in all the low places. Remember, a concentrated pool of such gas in a low area may be hard to detect. Meanwhile, you have a fire and explosion hazard.

Hydrogen is 14 times lighter than air and will rise above normal air. You could be breathing clean air under an explosive hydrogen blanket and not know it.

Handle compressed gas cylinders delicately. Dropping one on the floor can break the valve, creating a rocket that can easily go through a brick wall

while leaving a trail of explosive gas. If you knock two cylinders together hard, both might let go.

To reduce the likelihood of valve breakage, keep the cap screwed on any cylinder not in use. Shut the valve off if you are not using the cylinder, rather than leaving the regulator to act as a valve. If you leave the cylinder unattended overnight or longer, shut the valve off and remove the regulator to prevent breaking the regulator and the valve.

Shut off the valve and remove the regular if you are transporting the cylinder.

Never lift a cylinder by the regulator or the valve.

If transporting cylinders on a stairway, clear the stairway before making the ascent or descent. If you have problems getting the stairway roped off, ask your foreman for assistance. Do not carry the cylinders down a stairway that people are using.

Do not wrap hoses tightly. Exceeding their bend radius will result in a weak hose that may burst in use.

Inspect hoses before use. Replace any that appear cracked. Replace hoses that have a blister or other deformity.

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