#3 – 1101 Main Street, Penticton, British Columbia, V2A 5E6 Canada, phone +1 (778) 476 5833 fax +1 (250) 412 5681

16 November 2016

To:
Joshua Ojierenem
Project Manager
By Email: Joshua.Ojierenem@gov.yk.ca

RE: RECOMMENDED FUSE SIZES AT FARO MINE – (REVISION 2)

Dear Joshua,

Previous inspections and engineering assessments of the site electrical systems at Faro mine had raised concern with respect to the makes and models of 4160V overhead fuses that are in use.

Specifically, the fuse makes, models and sizes are unknown for the majority of the site. Labels are weathered and worn, and most fuse sizes cannot be confirmed without taking an outage.

There is also concern that a number of aged porcelain fuse holders are at an elevated risk of failure in the event that fused cutouts are pulled or operated under load.

These items of concern pose a range of potential safety hazards for the following reasons:

a) Arc flash assessments for the downstream low voltage systems cannot be considered accurate unless the fuses are known.

b) It is possible that incorrect fuse sizes may be present in some locations.

Oversized fuses may not clear a fault in a timely manner which can result in an increased arc-flash and/or fire hazard. Undersized fuses may be an operating liability that result in nuisance power outages.

c) Aged porcelain fused-cutout holders are liable to shatter with force if they fail in service, posing a safety hazard to operators.

Part of our scope of work was to assess the overhead fuses and plan for replacements. Given that many fuse holders should be replaced, regardless of the fuse type that is installed in, it made no sense to take outages to inspect the internal fuse links in more detail.

We have therefore simply tabulated the recommended replacement fuses for each active load location.

During the winter period when it is easier to take outages, Yukon Government (YG) may opt to have some or all of the unknown fuses replaced with the fuses listed in this document.

Selection Criteria

We have selected fuses according to the following criteria:

- All recommended fuses are S&C Electric, Type SMU-20 fused cutouts, Standard Speed, rated for 14.4kV or higher, as these are routinely stocked by Yukon powerline contractors.
- We recommend replacing fuse holders with S&C polymer type SMD-20, 14.4kV. The part number for this assembly including the required mounting brackets is 92142R3-P.
- Fuses are selected as small as possible to limit the arc fault hazard on the transformer secondary side, while being able to clear transformer inrush and supply the full load rating of the transformer.
- In a few cases where the downstream arc fault hazard was greater than 12 cal/cm^2, we have considered some fuses that are smaller than the transformer full load rating, provided that the transformer inrush can clear and the actual site load can be supplied with a reasonable ampacity margin. This allows the hazard level to be managed below 12 cal/cm^2, at which point a full arc-flash suit is not typically required.

Inline Fuses

There are a number of locations where fused cutouts are used in the overhead line as a convenient switching point and are not dedicated to any particular load or drop. These fuses have not been considered in this assessment as they are considered, for protection purposes, to be non-essential redundant items.

We suggest that the Yukon Government contact the local line contractors and/or utility supply companies for a quotation to:

a) Supply of fuses to replace the unknown units.

b) Supply replacement fuse holders for the older porcelain style holders.

c) Perform onsite installation of the above items.

Once the quotations are received for the above, we would be happy to assist YG with the selection and execution of these fuse replacements. Any replacements must be documented for future reference.

Prioritizing Fuse Replacements

In the context of limited budget availability for a wide range of necessary electrical projects, we believe that many of these fuse replacements can be considered a very low priority.

Technically it is beneficial to have all 21 sets of fuses replaced, but we consider only 4 sets to be a worthwhile priority at this time.

Replacement of the other fuses will result in only a marginal improvement in safety, and we would not consider them to be specific non-compliance in need of immediate attention, unless any obvious damage (cracking) is subsequently noticed upon inspection.

The five sets that we recommend for priority change-out are identified as follows:

Faro Mine Priority Fuse Changes					
Location	Transformer Size	Estimated Current Fuse Size	Current Arc Flash Rating With Estimated Fuse Sizes (cal/cm^2) at specified working distance (inches)	Recommend Fuse Size	New Arc Flash Rating With Recommended Fuse (cal/cm^2)
Propane Shack	1 x 15kVA, 1ph	No Fuse !	Undefined, Considered High Hazard / Fire Risk	5E	0.7 @ 18”
Intermediate Pond, nd8a	3 x 167kVA, 3ph	100E	14.8 @ 18"	65E	6.5 @ 18"
Miller Skid, nd2a	1 x 1000kVA, 3ph	200E	20.9 @ 18”	150E	11.4 @ 18”
Little Creek, nd86a	1 x 1000kVA, 3ph	200E	34.5 @ 18”	100E	11.6 @ 18”

These 4 specific fuse sets were selected due to the high arc-flash hazards on the secondary side of the transformers. By installing the recommended optimal fuse sizes, Arc flash hazards will be reduced below 12 cal/cm^2, that being the threshold at which a full arc-flash suit is required.

Replacement of other fuses on the full list may reduce the arc flash hazard level, but will not make a significant difference in the type of Personal Protective Equipment (arc flash clothing) that is required.

Accordingly, if there is no visible damage or deterioration to the fuse-holders, we consider them to be a very low priority for replacement.

New Transformer Installations at Faro Workshops and Guardhouse Parking Lot

We understand that YG is proceeding with the installation of new transformers and new fuses in these locations. Recommendations for optimal fuses at these two locations are as follows:

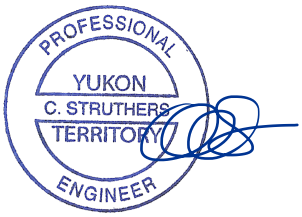
1. New Faro Workshops 3x100kVA, 4160V to 600V Transformer: 50A fusing should be placed upstream of the transformer to protect it.
    a. Recommended 50A fusing: S&C Model SMU-20 50E
    b. Up to 65A model would be acceptable by code.

2. New Parking Lot (Outside of Guardhouse Entrance) 100kVA, 4160V to 120/240V Transformer: 30A fusing should be placed upstream of the transformer to protect it.
    a. Recommended 30A fusing: S&C Model SMU-20 30E
    b. Up to 40A model would be acceptable by code.

If the Contractor has already purchased alternative fuses, please forward us the specifications and we would be pleased to review them.

Sincerely,

Struthers Technical Solutions Ltd.



Chris Struthers, P.Eng.

Note: Recommend replace all fuse holders unless otherwise noted with S&C SMD-20 Polymer Type. All fuse links types should be S&C SMU-20 Standard Speed, unless otherwise noted.

Location	Transformer Size	Recommend Fuse Size	Alt. Fuse Size	Priority	Notes
Faro Filter Trailers, nd9a	75kVA 3ph	15E	20E	Low	The lower fuse size is recommended for reducing arc flash hazard.
Intermediate Pond, nd8a	3 x 167kVA, 3ph	65E	80E	High	The lower fuse size is recommended for reducing arc flash even though it is rated slightly below the transformer full load amp rating (69A).
Parking Lot outside Guardhouse Entrance, nd7a	3 x 100kVA, 3ph	SEE NOTES		* In Progress	Transformers are being replaced with a single 100kVA 4160:240/120V model. Old fuse holders visibly cracked, so new fuses required. We recommend a 30E fuse size, but up to 40E would be acceptable by code.
Parking Lot inside Guardhouse Entrance, nd6a	3 x 100kVa, 3ph	50E	65E	Low	The lower fuse size is recommended for reducing arc flash hazard.
Small transformer to propane shack, in parking lot inside Guardhouse Entrance	15kVA, 1ph	5E	n/a	High	This transformer presently has no dedicated fuses, and is not code compliant. Code requires new primary fuses to be installed.
Norcan Shop, nd5a	3 x 100kVA, 3ph	50E	65E	Low	The lower fuse size is recommended for reducing arc flash hazard.
ETA, nd4b	3 x 100kVA, 3ph	50E	65E	Low	The lower fuse size is recommended for reducing arc flash hazard.
Interim Water Treatment Plant, F-805	1 x 2000kVA, 3ph	300E		N/A	Existing fuse is SMU-40 rated 300E, **no need to replace this one**. There is a high arc-flash hazard on the 600V side, but this cannot be reduced by modifying fuses. The lowest practical fuse size is already in use.

Note: Recommend replace all fuse holders unless otherwise noted with S&C SMD-20 Polymer Type. All fuse links types should be S&C SMU-20 Standard Speed, unless otherwise noted.

Location	Transformer Size	Recommend Fuse Size	Alt. Fuse Size	Priority	Notes
Miller Skid, nd2a	1 x 1000kVA, 3ph	150E	200E	High	The lower fuse size is recommended for reducing arc flash hazard. Note that 4160V indoor fuses are located at the primary side of the transformer, but they are oversized and result in a very high arc flash hazard. We recommend placing the lower rated 150E fuses on the overhead line switch for improved safety. Also note that this transformer may be slated for disconnection and replacement with outdoor pole-top transformers to allow demolition of the otherwise unused building.
Faro Workshops, nd15a	1 x 750kVA, 3ph	125E	150E	* In Progress	The indoor 750kVA transformer is being bypassed and the loads will instead be served by an outdoor bank of 3 x 100kVA transformers. We recommend the new bank be served with new 50E fuses. Up to 65E size would be acceptable by code.
Faro Pit Pump Station, nd66a	1 x 500kVA, 3ph	80E	100E	Low	The lower fuse size is recommended for reducing arc flash hazard.
Zone 2, nd56a	1 x 75kVA 3ph	15E	20E	Low	The lower fuse size is recommended for reducing arc flash hazard.
Zone 2 Area Heat Trace, nd57a	1 x 75kVA, 1ph	20E	25E, 30E	Low	The lower fuse size is recommended for reducing arc flash hazard.
Rose Creek, nd60b	1 x 500kVA, 3ph	80E	100E	Low	The lower fuse size is recommended for reducing arc flash hazard.

Note: Recommend replace all fuse holders unless otherwise noted with S&C SMD-20 Polymer Type. All fuse links types should be S&C SMU-20 Standard Speed, unless otherwise noted.

Location	Transformer Size	Recommend Fuse Size	Alt. Fuse Size	Priority	Notes
PW14, nd58a	3 x 100kVA, 3ph	50E	65E	Low	The lower fuse size is recommended for reducing arc flash hazard.
Seepage Interception Wells, nd59a	3 x 25kVA, 3ph	15E	20E	Low	The lower fuse size is recommended for reducing arc flash hazard.
Van Gorda WTP, nd71a	1 x 225kVA, 3ph	50E	n/a	N/A	The S&C type XS 25kV class fuse holder is relatively new, no need to replace it.
Groucho Pond, nd72a	1 x 225kVA, 3ph	50E	n/a	N/A	50E is the idea fuse size.
Van Gorda Workshops, nd75a	3 x 100kVA, 3ph	50E	65E	Low	The lower fuse size is recommended for reducing arc flash hazard.
V15 Area, nd84c	3 x 25kVA, 3ph	15E	20E	Low	The lower fuse size is recommended for reducing arc flash hazard.
Swimming Hole, nd85a	3 x 25kVA, 3ph	15E	20E	N/A	Fuse label shows a 7.8A presently installed, ***no need to change this if nuisance-tripping has not been a problem.***
Little Creek, nd86a	1 x 1000kVA, 3ph	100E	125E	High	Both fuse sizes are lower than rate FLA of the transformer, but comfortably higher than the full load current at Little Creek. The reduced fuse sizes are required to keep the arc flash hazards within manageable levels. Code would allow a fuse size up to 200A, but this would result in extremely high hazard level.
Van Gorda pit Pumps	350 HP Pumps	150E (Each motor)		Low	Fuses selected to pass motor inrush current for up to 4 starts in close succession. Motor and cable thermal protection is provided by the 4160V motor relay and vacuum contactor.
Grum Pit, nd88a	3 x 100kVA, 3ph	50E	65E	Low	The lower fuse size is recommended for reducing arc flash hazard.