RAIL SWITCH DE-ICING SYSTEM

FOR ELIMINATING WINTER ICING PROBLEM

INTRODUCTION

A major problem related to rail switching mechanisms in winter time is freezing due to extreme ambient low temperatures. Such cold environments are common in North America, Canada, Alaska and Nordic countries in Europe.

Photo 1: Rail Switch Central Station

Photo 2: De-icing activity

STANDARD SOLUTIONS

Chemical and Gas Burners

There have been many attempts to eliminate ice formation by either pouring ñchemicalsò or by applying ñheatò. Adding chemicals is not only expensive and poisonous but also pollutes the environment. The other common method is to apply heat to rail segments by any means possible. Since the early modern times of railroads and up to recent days, gas burner torches have commonly been used to heat the switching rail segments and to melt the ice, Photos 1 &2.

Electrical Elements

Using standard electrical heating elements is another common practice in de-icing the rails. However due to poor **interface contact** between heating elements and the rail, very low efficiency heat transfer is obtained. Such systems are not powerful enough to melt the ice in cold winter environments of North America such as in Canada and

NORAX CANADA INC.
700, rue Perreault, Saint-Romuald (Québec) G6W 7V6
Tel. : 418 834.5175 | 1 866 836.2523 | Fax. : 418 834.5089
www.noraxinduction.com

Alaska. Heating elements alone cannot totally eliminate the rail freezing problems. These systems also require continuous maintenance and service of the segments. Photos below #3 shows a heating element attached to the rail and its performance under a snow storm is shown in Photo #4. The average electrical power of these elements varies from 5 kW to 15 kW depending on the location, installation site and coldest expected ambient temperature.

Photo 3: Heating element attached to rail

Photo 4: Switching segment during snow storm

STANDARD INDUCTION SYSTEMS

Induction superior performance in heating conductive materials is well established in the industry and it offers higher efficiency and excellent energy coupling with metallic charges. There have been many attempts to use induction heating technology for heating the rails. However, conventional induction solutions are difficult to install, to maintain and are too expensive for multiple usages.

The major problem related to induction installations is caused by the variation of free surface available on the rail surface for mounting the induction coils as shown in Photo #5. Installation is complicated by the many different spacing between the joints connecting the rails together and as well as the base rail tie interface.

Such installations require that many coils (for each section) having different lengths be connected to individual power supplies that are calibrated for each specific coil. This mandates that the induction units be custom made for each coil and thus makes it very difficult to install, maintain or repair the coils or power supplies.

In addition, such power supplies are difficult to install in remote locations as they must be designed or calibrated individually for every particular coil segment during installation or eventual service works.

And last but not least is that common induction systems may impose extra electrical voltage and noise on the rail and thus affecting rail high tech security control signals.

These conditions combined make standard induction solutions too complex to control, too difficult to service and too expensive for multiple installations.

Photo 5: Different segments of Joints and ties on the rails with different available spacing for installing the induction coil.

THE NORAX INDUCTION SOLUTION

Norax Canada is a manufacturer of induction heating systems based on a US and Canadian patented technology. This allows us to manufacture power supplies that are both compact and efficient using minimum components and having highest efficiency. In addition Norax power supplies are extremely versatile and can be designed for almost any application. For further information please visit www.noraxcanada.com .

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RAIL SWITCH DE-ICING SYSTEM

- **Low operating cost**
- **Low power requirement**
- **Low maintenance**
- **Flexible design**
- **No EMI interference**
- **Compact unit**
- **Fault detection**
- **Automatic controls**
- **Simple installation**
- **No environmental impact**

Norax Canada is pleased to introduce its new Rail Switch De-Icing System ***RSDS*** using induction technology. The system consists of a main 10 kW induction generator which can energize up to 16 induction coil segments. The standard coil lengths are 10ò, 20ò, 30ò, 40ò and 50ñ, photo #6. Multiple coils in any combinations and up to 300ò in total length can be attached to one power supply at free positions available on the side surfaces of the rails close to switching sections.

The coilôs terminals are electrically connected to each other in ñseries combinationò, photo #7. The free ends of the first and last coils are then connected to a power supply and the power supply is placed in the nearest available electrical cabinet.

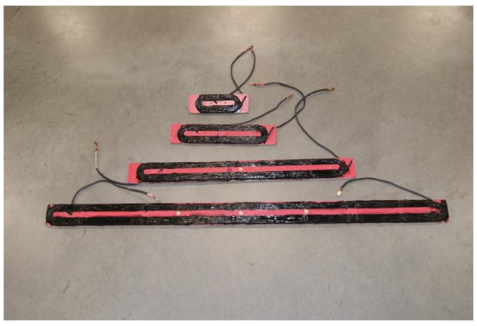

Photo 6: Four standard coils with length of 50, 30, 15 and 10 inches.

The rail segments to be heated by ***RSDS*** induction are covered with multiples of coils based on the available space and in any combination or order.

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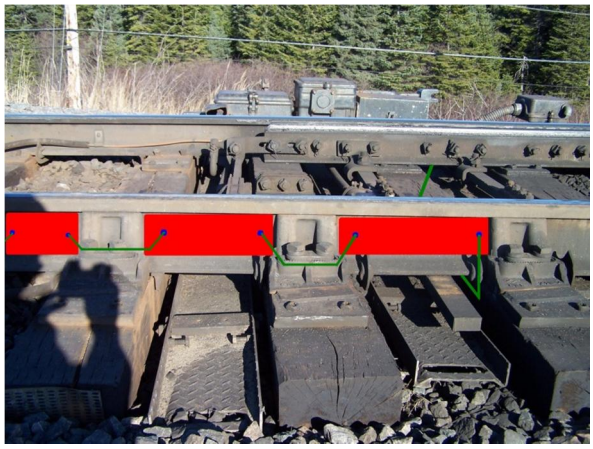

Photo 7: Coils are attached to side rails by pair of stainless steel screws and are connected electrically in series.

The total length of installed coils is ~ 150ò per rail or up to 25 feet of total length for both sides. These coils are then connected to the individual 10 kW Noraxô RSDS power supply, photo #8.

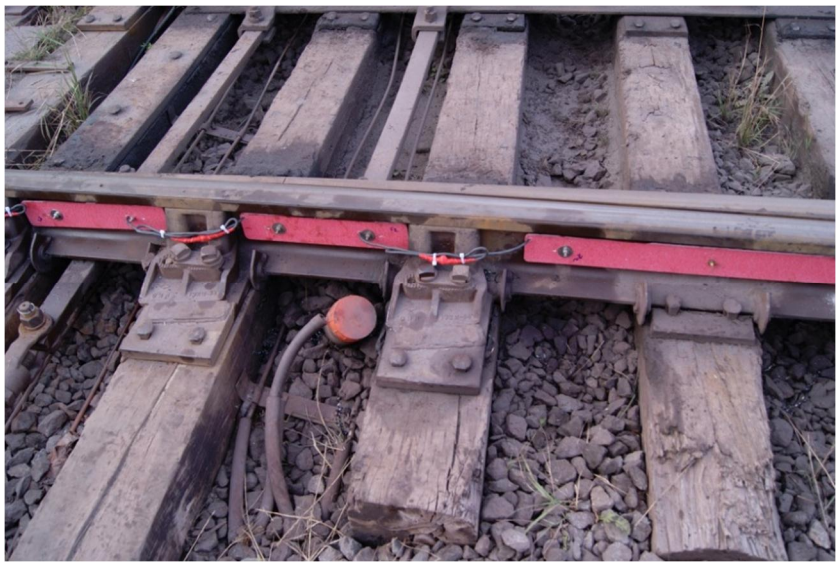

Photo 8: Coil is attached to the rail by stainless steel screws.

The total length of the induction heated zone is then 300ò or 25 feet. These coils are powered by a 10 kW induction system working at 20 kHz. This results in a linear power density of 400W/ft. This power is high enough to maintain the rail temperature above freezing point even when the ambient temperature is below -35°C (-31°F).

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Photo 9: Installation of the power supply in nearby electric box.

The power of one RSDS generator is designed to maintain the temperature of only one switching rail station and therefore it is recommended to have one power supply for each switch unit.

Photos 10, 11: Induction coil segment and snow cleared around the switching rail, especially at the critical tip point.

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The *RSDS* Induction power supply is designed to work with the universal voltage of 208 to 240 volts, single or 3 phase. The working frequency of the system is ~20 kHz which results in high efficiency, compactness and low electrical noises. Power supply should be installed in the nearest electric box. The box is equipped with small heater to avoid freezing of the electronic components in sub-zero temperatures.

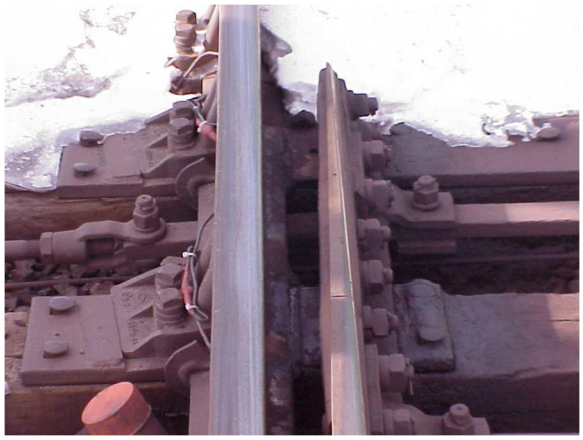

Photo 12, Ice free tip of switching rail

Photo 13: induction coil segments near the Switching rail

Photo 14: Ice free area around the rail switch

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Temperature Control

The rail temperature is monitored by a ñBi-metal Switchò set at ~15°C (60°F). Please note depending on the location of the switch, any other Bi-metal Switch with different temperature settings (up to 30C) can also be selected and installed. As rail temperature falls below the set point, generator turns on automatically and maintains the temperature by varying (NO-OFF) cycles.

As an option, an advanced version with thermocouple and temperature regulator can also be offered. In this version, the rail set point temperature can easily be programmed by the temperature regulator which adjusts the power through a PID signal.

The recommended power supply has the capability of delivering up to 10 kW at full power. The picture below shows power supply working at ~7 kW sufficient to maintain the rail temperature at set point of +15 C when ambient temperature is below -20 C. The duty cycle of the power supply under above condition was ~ 70%, indicating it has reserve power to work at even lower temperatures of -30C or less.

Photo 15: Power supply working at7 kW

Working Voltage

Power supply is designed to work with any voltage available, 220V to 240V single phase or 3 phases 208Volts. Power supply automatically detects the line voltage and adjusts the internal parameters instantly.

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Cooling System

Power supply electronics, power transistors and coils are designed to work without cooling water. Thanks to Norax patented technology, natural convection is sufficient for continuous operation of the induction system at full power. This eliminates problems related to circulating cooling water normally required for conventional induction heating systems.

***RSDS* General Technical Specifications**

Power Supply Technical Specifications:

Output Power	0-10 kW @ 20 kHz
Universal Input Voltage	220-240 V, single phase, 40 Amp, 50/60 Hz
	208Volts, 3 phases, 28 Amp, 50/60 Hz
Dimensions	H=25, W=17ò, D=10ò
Cooling System	Heat sink with internal fan
Temperature Control Hakims	Bi-metal switch
Optional	Thermocouple with PID controller

RSDS Installation

Induction generator is designed for universal supply voltage and can easily be connected and installed by rail way technical staff. Induction coils can also be easily installed on the rail and be exchanged for repair works. It is maintenance free and fully automatic. Power supply automatically detects coil numbers and combinations and adjusts parameters instantly.

Maintenance

The ***RSDS*** Power Supply design is based on Norax patented technology and offers a very long trouble free service life. It is equipped with a fault detection system which automatically measures the internal operating parameters. In the rare case of a malfunction, a fault signal will be send to central station indicating a fault status. Power supplies can easily be replaced by another unit without any need for fine tuning

or adjustment of electronics and or changes in the matching box parameters. A step by step manual describes how to install and replace the power supply for rail way technical staff.

Fault Detection and Alarm System

The ***RSDS*** Power supply is equipped with special circuitry which monitors and indicates the statue of the power supply and its operation. The status of the power supply is transmitted by the ñclosedò contact of a signal relay. If, due to any internal faulty electronics, power supply or any of coils are out of function, the status is presented by an (open) signal from the signal relay. This indicates malfunction of the generator and need for service and repair. This relay can easily be added to existing signal controls of the rail. The alarm signal status can be connected to central network and control centers.

Security Signal and EMI

It is most important to emphasise that Norax induction system and it coils do not impose any voltage, false signal or interference on the entire rail/switching network security circuits.

Due to the special design of the power supply, its operating frequency, coil configuration and its attachment mechanism to the rail, there is no electrical noise imposed on the rail security circuit. All the electrical Eddy currents are local and are neutralized instantly outside the coil surface.

Electrical Operating Cost

The operating cost per system is roughly $0.70/Hr at full power. The power consumption is zero as soon as the rail temperature is above the set point.

Norax Engineering team would be pleased to visit you and with your input, determine your needs and installation requirements.

For further information please contact us at:

Hamid Shahani, PhD / Norax Canada Inc.
e-mail : hamid@noraxcanada.com
phone: 418-834-5175

Bob Drake / Consultant
e-mail : europelink@aol.com
phone : 631-749-1100